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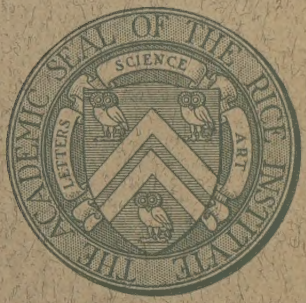

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WHAT IS MAN?[1]

I

THE HUMAN SPECIES

1. INTRODUCTION

I AM not so vain as to suppose that I can give any complete or satisfactory answer to the old question of the Psalmist, "What is Man?" embracing as it does every aspect of every type of human being and of every form of the multitudinous activities of men in all parts of the world throughout a hundred or more centuries. Any attempted answer must necessarily be incomplete and hence unsatisfactory, and it must partake of the limited nature, experience, and knowledge of the person who undertakes it.

Multitudes of books have been written in answer to the question, "What is Man?" Indeed all books ever written are partial answers to this question; all sciences, literature and art; all history, social institutions, and religions must be taken into account in attempting any complete answer. This is enough to indicate that the whole experience of the human race must be drawn upon in any comprehensive consideration of this subject. The impracticability if not impossibility of such an undertaking suggests the necessity of dividing, classifying, and analyzing its contents and of

[1]A course of three public lectures delivered on the Sharp Foundation of the Rice Institute, May 7, 8, and 9, 1941, by Edwin Grant Conklin, Ph.D., Sc.D., LL.D., Professor Emeritus of Biology at Princeton University, Executive Vice President of the American Philosophical Society.

dealing with only a few aspects of this all inclusive subject.

A partial analysis and classification of the various aspects of human nature and activity may be outlined under the following headings:

A. Objective or realistic phenomena, including the (1) biological, (2) anthropological, (3) ethnological, (4) psychological, (5) sociological, (6) historical. B. Subjective or idealistic aspects, such as the (7) self-conscious, (8) emotional, (9) artistic, (10) ethical, (11) humanistic, (12) religious. The former has been called the outer or public, the latter the inner or private aspect of man.

Such a classification is not only incomplete but it unduly emphasizes the distinction between these various aspects of man. It is useful, as all analyses are useful, as a means of accommodation to our limited intelligence which is able to consider effectively only one phase of anything at a time; but it is harmful if it leads to the conclusion that any of these various aspects of man is complete in itself, or that a real human being can be divided into these different categories. These are mere aspects or points of view of a many-sided object-subject which remains an indivisible unity; furthermore most of these subdivisions overlap to such an extent that no sharp separation of one from another is possible. Throughout all phases here classified as objective aspects of man runs the idealistic thread of subjective thought and experience; underneath all subjective phases is the basis of objective science.

Formerly the attempted answers to this great question emphasized the idealistic characteristics of man. "Thou hast made him a little lower than the angels," said the Psalmist. "Man is a spirit, an immortal mind and soul, temporarily housed in a mortal body," say the idealists. With the growth of objective science emphasis has swung

to the opposite extreme, "Man is an animal, one of a million other species of animals. Mind and emotions are mere functions of the body," say these scientists. This objective aspect of man has almost completely obscured or eliminated the subjective phase in modern scientific writings and has sometimes led to a denial of the reality of consciousness, freedom, and purpose, apparently with the thought that things which cannot be explained by mechanistic science must be explained away.

A multitude of recent books have dealt with man from the objective or more strictly scientific point of view. Among some of those which have presented ably the biological aspects are Jennings' *The Biological Bases of Human Nature,*[1] Haldane's *Science and Human Life,*[2] and most recently Sherrington's *Man on his Nature.*[3] These books adhere to the strict canons of mechanistic science and touch only briefly if at all upon subjective phenomena. Another book which has had a great popular appeal because it attempts to combine in a scientific setting the objective and subjective aspects of man is Carrel's *Man the Unknown.*[4] Its discussion of the physiological and medical aspects of man conforms to the usual methods of science and shows that although much is known regarding these phenomena much remains unknown. But in its defense of extra sensory perception, telepathy, clairvoyance, miraculous healing, etc., it departs widely from the accepted methods and conclusions of objective science. Although this book has had a great reception among the non-scientific public, and especially by those who have feared and dreaded the applications of the methods of objective science to the study of

[1]H. S. Jennings. New York, Norton, 1930.
[2]J. B. S. Haldane. New York, Harpers, 1933.
[3]Sir Charles Sherrington. New York, Macmillan, 1941.
[4]Alexis Carrel. New York, Harpers, 1935.

human nature, it has in general met with a cold reception by the scientists; this applies especially to those parts of the book which attempt to correlate objective science with subjective phenomena.

Other recent books on human nature deal more fully and frankly with the emotions, aspirations, and ideals of man, from the idealistic point of view, although with certain recognition of the rights of science in its own field, which is usually interpreted as the objective field only, although sometimes suggesting that science may some day be able to deal with subjective phenomena. One of the best of these is by W. Macneile Dixon, formerly Professor of English Literature in the University of Glasgow, and is entitled *The Human Situation.*[1] It consists of the Gifford Lectures at the University of Glasgow for 1935–37. Another book in this class is by a former colleague of mine at Princeton University, the late Professor Archibald A. Bowman, Professor of Moral Philosophy in the University of Glasgow from 1926 until his death in 1936. His lectures on the Vanuxem Foundation at Princeton in 1934 have recently been published under the title, *A Sacramental Universe.*[2] This book regards not merely man, but the entire universe, as the title suggests, as a "Conjunction of physical and subjective systems . . .," the sacramental character arising "through a prior union of the physical and the subjective in a mode of being which reveals itself . . . either as embodied spirit or as the living body." Finally Reinhold Niebuhr of the Union Theological Seminary has just published his Gifford Lectures, under the title, *The Nature and Destiny of Man.*[3] These books deal with man and his relations to the universe with a wealth of literary, historical,

[1]New York, Longmans, 1938.
[2]Princeton University Press, 1939.
[3]New York, Scribners, 1941.

and philosophic erudition. But none of these distinguished scholars treats of man from that point of view with which I am most familiar, namely, the developmental. They consider man in his fully developed state as a self-conscious personality or embodied spirit. I propose to reverse this procedure and to deal with him in the process of his becoming what he now is, and of forecasting, as far as that is possible, where he is going.

I may say at once that I am fully convinced that all phases of human nature are amenable to scientific treatment and must be studied, if studied at all effectively, by scientific methods. These methods consist of careful, systematic, verifiable observations of phenomena, and logical deductions as to their causes, which deductions are then tested by further observations and, whenever possible, by experiments aimed to segregate or isolate various factors or causes. It is more difficult to apply such scientific methods to the study of man than in the case of other organisms, and it is most difficult to apply them to subjective phenomena. But in spite of all difficulties much progress has been made in the scientific study of the entire man.

There are some mathematical and physical scientists who would deny the name of "science" to any investigation that cannot be expressed in mathematical formulae. To them science is measurements and numbers, and consequently there is very little in the study of man that they would recognize as their kind of exact science. But there is a vast deal of organized knowledge, which cannot now be expressed quantitatively, and which is known as descriptive science. Here must be classed most of the natural sciences such as geology, biology, psychology, anthropology, ethnology, and sociology. Some of these are gradually passing from the descriptive to the experimental stage, but a vast

deal of knowledge in these fields cannot be expressed in quantitative terms.

Three principal methods have been employed effectively in biology in seeking to analyze phenomena and to determine their causes. The first of these is the method of *comparison,* by which similarities and dissimilarities are observed, general conditions are distinguished from special ones and thus relationships are established; the value of this method has been demonstrated in comparative anatomy, physiology, psychology, and in fact in all the natural sciences. The second of these methods is that of *development* which analyzes complex phenomena by tracing them back through their development to simpler and simpler conditions; the value of this genetic method is recognized in all the natural sciences. The third method is that of *experiment* which seeks to determine the causes of phenomena by eliminating certain factors or changing certain conditions and noting the results; if carefully carried out and with adequate controls, that is, comparisons with unchanged conditions, the experimental method is the most exact of all.

In a scientific study of man all of these methods have been employed with marked success, although experiment is often impossible and adequate controls are generally lacking. Nevertheless such scientific methods of investigation are often repudiated by persons who regard man and especially human personality as above and beyond scientific analysis. Such methods of analysis are denounced as "biological naturalism." I once heard a former President of Princeton University describe with inimitable humor the new kind of scientific psychology which studies the behavior of monkeys (comparison), of babies (development), and of idiots (nature's experiments), instead of beginning and ending with the introspective study of mind and soul.

However, the study of the behavior of animals, especially primates, and of genetic psychology, defective mentality, pathological psychology, and psychoanalysis have thrown a flood of light upon hitherto obscure phases of normal psychology and have completely justified the scientific and naturalistic approach to some of the most complex phenomena of human personality.

As a biologist I propose to begin with a consideration of man as a biological organism who has developed out of a condition that is neither self-conscious nor spiritual in any sense in which other living creatures and the universe itself are not self-conscious and spiritual and then to consider the steps by which man has become a self-conscious personality, for I assume that no one capable of keen observation and deep reflection can really deny the fact that man has in his racial and individual development reached a stage in which he is a self-conscious personality, capable of forming rational judgments and purposes, that he has a sense of material and moral values, and in these respects may be said to be spiritual. The scientific study of man must be limited to the natural and it seeks to show the steps by which there develop out of relatively simple biological beginnings the amazing complexities of body and mind, of social and spiritual phenomena.

In these lectures I shall deal first with man from the biological point of view, then from the psychological and social standpoints, and finally I shall endeavor to correlate these findings of science with the philosophical problems involved in self-consciousness, a sense of material, moral, and aesthetic values, and the attainment of freedom and responsibility. The first lecture then may be entitled "The Human Species," the second "The Development of the Individual," and the third "The Real and the Ideal."

2. RACES AND TRIBES OF MEN

If a naturalist were asked "What is Man?" he would answer, "Show me the specimens." Viewing man as a biological object what do we see? About two thousand million living individuals, sufficiently alike in morphology and physiology to warrant their being classified as a single genus and species, *Homo sapiens,* and yet so different in inherited colors, bodily features, and proportions as to require their being classified in at least three primary races, the white, yellow, and black, or in the terms of Cuvier, the Caucasian, Mongolian, and Negro. Apparently the Old Testament classification into descendants of Shem, Ham, and Japheth does not recognize the Mongolian. Huxley added to Cuvier's three a fourth race, the Australoid, and other anthropologists have added the brown or Malay and the red or Amerind. In addition to these three to six primary races there are several minor subraces with more or less distinct hereditary characteristics, just as there are many breeds of horses, cattle, sheep, and other domestic animals.

"Species" is a biological concept hard to define, but there is general agreement that the best single characteristic of a species is ability of individuals of the two sexes to interbreed and produce fertile offspring. There may be a few exceptions to this rule but in general it holds true. All races and subraces of *Homo sapiens* do interbreed and produce fertile offspring. The biological basis for this is found in the behavior of the chromosomes in the formation of the germ cells and in their union in fertilization. All existing races of men have the same number of chromosomes in every one of their cells, namely forty-eight, half of which are from one parent and half from the other. Although every chromosome differs from every other one, the twenty-

four from the mother are so much like (homologous with) the twenty-four from the father that they can unite into twenty-four homologous pairs, which then separate at random in the cell divisions leading to the formation of eggs and sperms, so that each egg or sperm contains only one of each of these pairs of chromosomes of maternal or paternal origin. When such an egg is fertilized by such a sperm the full number of forty-eight chromosomes is restored. In this behavior of the chromosomes we have the explanation not only of Mendelian inheritance but also of fertility within a species and of sterility between different species, these being dependent upon the ability or inability of parental chromosomes to unite into homologous pairs.

Differences among Africans, Asians, and Europeans have sometimes been magnified to such an extent that these races have been classified as separate species. Defenders of African slavery used sometimes to deny that the Negro is human, but mulattoes demonstrated the contrary. Even within the white race distinctions between Nordics, Alpines, and Mediterraneans, and between so-called "Aryans" and Jews have been exaggerated beyond all science and reason.

On the other hand in the laudable attempt to combat so-called "raceism," or this exaggeration of racial differences, some humanists have gone to the other extreme and have virtually denied any racial differences, except possibly a few physical distinctions which are considered as only "skin deep." But of course the physical anthropologist knows that certain racial characteristics are found in practically every organ and system of the body, and these peculiarities are racial because they are inherited. Upon the existence of such inherited peculiarities all systems of biological classification rest. Of course such classification is not based upon the most extreme development of any character, but rather

upon the mean or "mode" in the curve of variation, and the fact that extremes of some characters of different races may overlap does not nullify such classification.

Structural peculiarities are associated with functional ones; indeed structure and function are inseparable in living things. Certain physiological peculiarities characterize different races, such as greater or less resistance to certain diseases. It is more uncertain whether temperamental, intellectual, and social qualities are inherited and hence characterize different races or even different families. Feeblemindedness sometimes occurs in brilliant families and a "black sheep" now and then appears in the best families, but these departures from type are probably the result of the outcropping of latent or recessive traits, or are due to unfavorable environment during development. There is a physiological basis for some temperamental and intellectual differences in the varying activity of certain endocrine organs, which may in turn be inherited, but it is also well known that environment is an important factor. Given a typical or normal inheritance I think the evidence indicates that the direction and degree of intellectual and social development depend in part upon environment, though both heredity and environment are indispensable in any and all development. Environment and training may do much to diminish temporarily racial differences; kinky hair may be straightened and white skin made brown, as popular sunbaths demonstrate, ignorance may be diminished and social usefulness increased, but heredity can be changed only by selective breeding. But certainly there is no scientific warrant for branding all individuals of some races as inferior and all of other races as superior. All races have their good and bad specimens, their good and bad qualities, and a sane and sensible world would prize the peculiar

talents of each race, each contributing its particular endowments to the infinite variety and wealth of life.

To the naturalist the differences between human races, subraces, families, and individuals are small indeed as compared with their manifold resemblances. Biology and the Bible agree that "God hath made of one blood all nations of men." Our common traits and origin and fate, our common hopes and fears, joys and sorrows would call forth our common sympathy with all mankind, if it were not for the lessons of hate which have been cultivated and instilled by selfish and unscrupulous persons and social groups. These racial antagonisms are not the results of inexorable nature, nor of inherited instincts, but of deliberate education and cultivation.

There are primary and secondary human races with characteristic morphological and physiological differences that are inherited, and the same may be said of many of their psychic and social differences. There are also many breeds or stocks or families within these human races with hereditary characteristics that distinguish them from one another. These characteristics may be useful or harmful or indifferent depending upon our ideals of values, and since these ideals may be emotional rather than rational, notional rather than factual, they may be wholly erroneous. But certainly truth is not advanced nor justice promoted by denying the evident fact of racial and hereditary differences among men.

Nevertheless in spite of all these differences which may be classed as racial, subracial, or familial, all living human types are so much alike that they can and do interbreed and produce fertile offspring. By general agreement among naturalists this fact indicates that all types of living men belong to a single species, which was euphemistically named by the

great Swedish naturalist, Carl Linné in 1758 *sapiens*, or the wise, the knowing. All of these two thousand million living individuals, of the three to six primary races, more than four hundred subraces and tribes,[1] and innumerable hybrids, belong to a single zoological family, the *Hominidae*, a single genus, *Homo*, and a single species, *sapiens*. No other family, genus, and species of higher animals occupies so solitary a position in the animal kingdom, no other is so widely distributed over the earth's surface, no other is so dominant over all other animals and over all conditions of existence.

This dominion of man over other creatures and conditions has made it possible for man to occupy the whole earth. There is no region of tropic heat or polar ice where he has not penetrated, no mountain areas or plains or deserts he has not occupied, no conditions however adverse he has not attempted to conquer, usually with success. This dominion of man is due to his marvellous adaptability and his unique inventiveness. He not only adjusts his physiological processes to widely different environments, such as high and low temperatures and altitudes, various kinds and quantities of food and drink, numerous kinds of poisons and parasites, but he alone of all animals is able in large measure to control his environment, to modify or change climates by means of migration, clothing, housing, and air conditioning, and to bring food and drink and clothing from the ends of the earth.

3. THE PAST EVOLUTION OF MAN

This unique animal was not suddenly and miraculously launched into the world some six thousand years ago, as many have supposed, following Archbishop Usher's chro-

[1]See *Encyclopædia Britannica*, 11th ed. Index p. 883.

nology, but he came up through a long line of prehuman ancestors by a process of mutation and transformation such as has since led to the establishment of the various races of men. The theory of evolution has provoked controversy between realists and idealists ever since it was proposed in one form or another by Greek philosophers and naturalists. That controversy became intense with the publication of Darwin's *Origin of Species* in 1859; it was marked by violent opposition and emotional advocacy, but gradually scientific realism prevailed and there is now little if any scientific or philosophical opposition to the theory, although theological antagonism flares up from time to time, as in the campaign led by William Jennings Bryan. This opposition was directed especially against the theory of the evolution of man, and in particular against the natural origin of mind and morals. Language, reason, and ethics were held to be direct gifts of God, although the body of man might have been produced by evolution.

At present practically all scientists and philosophers as well as many theologians consider that man in his entirety, body, mind, and morals, has arisen by a process of evolution. This is a conclusion of vast importance, as revolutionary in its field as was the Copernican Theory in the field of astronomy. As Professor Jeans has said, "Man no longer sees nature as something distinct from himself." He also is a part of nature and all his characteristics are products of natural processes. Such a conclusion is generally known as "Naturalism" as contrasted with "Supernaturalism," and it has led to a revolution in science, philosophy, and religion. John Fiske said many years ago, "The great theory of evolution is rapidly causing us to change our opinions on all subjects whatsoever," and Macneile Dixon has recently said, "Since the Renaissance there has been no such upheaval

of thought, no such revaluation of values, as in the century upon which we have entered."

I shall not attempt here to deal with the evidences in favor of general evolution; this is now an old story and although there is much about it which we do not understand, many factors that remain to be discovered or explored, the fact of evolution is no longer questioned by men of science. Any admission that biologists do not know everything about the causes of evolution is sure to be seized upon by critics as evidence against the fact of evolution; but there are few things in the world whose causes we know fully, and yet this is no evidence against their existence, e.g., matter, energy, electricity, life, mind, morals, crime, insanity, cancer, etc., the causes of which are not fully known and yet their reality is beyond reasonable question. Let us turn then to some of the evidences of the evolution of the human species, *Homo sapiens,* seeking in his origin the scientific answer to the question, "What is man?"

There is no doubt that man more closely resembles the great apes, that is the gorilla, chimpanzee, orang, and gibbon, than any other living animals, and yet no biologist supposes that man has descended from any of these present species of anthropoid apes. On the contrary, the present species of man and of apes are diverging further and further from one another, and, conversely, as their lines of descent are traced back through fossils of extinct species they converge. But even in existing men and apes we find that there is scarcely a single bone, muscle, nerve, gland, or other organ of man that does not have its counterpart in these apes. As Romanes has strikingly remarked, "Here we have a fact, or rather a hundred thousand facts, that cannot be attributed to chance and if we reject the scientific explanation of common descent of man and apes we can

only suppose that the Deity in creating man took the most scrupulous pains to make him in the image of the beasts." Some opponents of the simian ancestry of man who nevertheless recognize that these numerous resemblances between man and apes require a rational explanation have proposed that apes are the degenerate offspring of men. It is curious how much more pride some people take in their ancestry than in their posterity!

Archaeological researches show that the existing species of man, *H. sapiens,* appeared during or slightly before the last great ice age, some twenty to thirty thousand years ago. But before that time there were several species of men or near-men that have been traced back to a period of at least a half million and perhaps a full million years ago. I well remember the amazement and incredulity of the non-scientific world when Dr. Eugen Dubois in 1892 announced the discovery in Java of some fossils of a creature which seemed to fulfill the hypothetical requirements of a connecting link between men and apes and which he accordingly named the erect ape-man, *Pithecanthropus erectus.* Recently the discovery of other similar fossils in Java has proved that Dubois' specimen was not unique but was correctly identified as an example of a real genus and species of pre-human type, the most primitive and ape-like that has yet been found. Since 1925 several fossil skeletons of a form nearly akin to the Java man, together with crude stone implements, charcoal, and bones of extinct species of animals, have been found in a cave near Peking, China, and named by Davidson Black, *Sinanthropus pekingensis.* At present these are the earliest known fossils of human type, but there is good reason to believe that still earlier and more primitive forms existed and that their remains will ultimately be found.

For reasons that can be readily appreciated fossil remains of men and apes are not as numerous as those of lower animals; they did not exist in such numbers as many of the more common vertebrates and their remains were not so apt to be buried in alluvial muds. But during the past fifty years many skeletons of ancient men have been found and still more stone implements and artifacts have been discovered. Some of the crudest of these artifacts are known as eoliths and they often indicate where primitive men have been, even though their skeletons are now lacking.

These earliest known representatives of the human family, the *Hominidae,* used fire, made stone or flint implements, and were far more advanced in such culture than any animal. There must have been a long period antedating these earliest known remains from Java and the cave near Peking during which prehumans were learning to make stone implements and weapons and to use fire. Paleontologists generally hold that the earliest prehuman stock separated from the line that gave rise to modern anthropoid apes not less than two million years ago. Since the time when these two lines separated each has diverged more and more from the other so that living men and apes are now farther apart than ever before. More recent types of fossil men, now long extinct, are represented by remains of the "dawn man" found near Piltdown, England, and named *Eoanthropus dawsoni;* another, represented only by a massive, chinless lower jaw, found near Heidelberg, Germany, has been named *Paleoanthropus heidelbergensis.*

All of these more primitive types of the human family are usually classified by zoologists as distinct in genera as well as species from modern man. More recent types of fossil men belong to the same genus *(Homo)* as modern man but not to the same species. One of the earliest of these

is *Homo soloensis* of Java, which appears to have been a later development of *Pithecanthropus*. The most numerous and widespread of these early representatives of the genus *Homo* is *H. neanderthalensis,* which was first found in the Neanderthal, Germany, but has since been found in many parts of Europe and in certain portions of Asia Minor. He was a creature of beetling eyebrows, heavy jowl, retreating chin, hanging head, curved legs and probably shuffling gait, that flourished some twenty to fifty thousand or more years ago. Another extinct species of man which shows certain resemblances to the Neanderthal species has been found in Rhodesia, Africa, and named *H. rhodesiensis*.

We do not know that these genera and species of early man were actual ancestors of modern man, but it is noteworthy that skeletons of modern man do not occur along with these more primitive precursors of *H. sapiens*. Early remains of the present species have been found in various places in western Europe, and especially in southern France. Some of these are distinguished by their characteristic cultures, as represented by artifacts. Thus, following the Neanderthal period, which ended about twenty thousand years ago, there were the Aurignacian of about fifteen thousand years ago, the Solutrean of some twelve thousand years ago, the Magdelenean of about ten thousand years ago. The people of the last-named era were the Cro-Magnon race of a physical type equal to or even superior to present races. All of these early stages of culture belong to the Paleolithic or Old Stone Age. More recent stages down to the use of metals are known as the Neolithic, or New Stone Age.

The people of all these cultural ages were modern men in that they belonged to the present species, *H. sapiens*. The history of modern man probably began about twenty thou-

sand years ago. While this seems long as contrasted with Archbishop Usher's estimate of about six thousand years, it is still very brief as compared with the whole past history of living things on the earth. Professor James Ritchie of Edinburgh University, in his presidential address before the zoological section of the British Association for the Advancement of Science in September, 1939, put this in a striking form by comparing the whole past history of life on the earth, probably about twelve hundred million years, with the twelve hours of the clock from midnight to noon. Each hour of the clock would correspond to a hundred million years, each minute to one and two-thirds million years, each second to twenty-eight thousand years. The long Archeozoic and Proterozoic Eras, when protozoa and protophyta which left few if any skeletal remains were the principal living forms, probably cover more than half of the entire history of life and bring the time o'clock from midnight to six or seven in the morning. The Paleozoic Era, when fishes and amphibia were the highest animals, brings our clock to 10 A.M.; the Mesozoic, or age of reptiles, lasted until 11:30; the Tertiary, or Age of Mammals, began about 11:45. Primitive man first appeared less than a minute before 12, and *Homo sapiens* less than a second before our present noon.[1] Verily we are late comers in this grand procession of life!

4. PATHS OF PROGRESS

In this long course of past evolution we find that there has been general progress from the simpler and more generalized to the more complex and specialized forms of life. First appeared single-celled organisms, then many-celled

[1]These figures do not correspond exactly with Ritchie's. See revision of his address in *Annual Report,* Smithsonian Institution for 1940, pp. 249–269.

ones with many different organs and systems; first aquatic forms, then terrestrial and aerial ones; first cold-blooded animals, then warm-blooded ones; first those with little or no specialized sensory and nervous systems, then those with highly developed brains and sense organs.

This general evolutionary progress which is seen when taking the long view of life on earth has led to the view that evolution always implies progress, but usually no attempt is made to define that term. As long as man was regarded as the goal toward which all evolution leads, progress meant movement in the direction of man and man's highest ideals. But from a broad biological point of view progress means movement toward the universal goal of living things, namely survival. Any change in an organism which leads to increased chances of survival is progress toward that goal and for that species, even though it may involve degeneration and parasitism. Progress for one species may not be such for another, indeed progress for predators and prey, for parasites and hosts, run in opposite directions. Increased chances of survival for one species generally mean decreased chances for some other species. We must therefore distinguish between general progress from relatively simple structures and functions of early stages of evolution and mere increase in chances of survival which may involve regression to simpler conditions.

Even a cursory view of the living world would justify the conclusion that evolution has proceeded in all possible directions. Organisms today appear to occupy every place in nature where life is possible, whether on or in the earth, in the air, or in or under the sea. Living things have achieved this wide distribution by means of their unique ability of adaptation to many different conditions. Consequently we find almost infinite variety in form and function

of organisms from bacteria to man, each being more or less fitted to some particular place in nature.

The evolution of man, like that of other organisms, has been marked by increasing adaptations to conditions of existence, and these adaptations may be classified as physical, intellectual, and social, or progress in body, mind, and morals. Some of the chief steps in this progress have been (1) the assumption of erect posture with the consequent freeing of the hands from locomotion, (2) the growth of the cerebrum with increasing psychic functions of intelligence, reasoning, inhibition, and will, (3) the development of articulate speech and other means of communication which have made possible larger social units, and (4) the growth of the "herd" instincts of protection, cooperation, and fellowship. Each and all of these lines of progress have made for increased chances of survival for ever larger numbers of individuals; in short, they are evolutionary adaptations to conditions of existence.

All these lines of progress are interrelated, and yet within certain limits they are independent, as is seen by the fact that progress has not been at a uniform rate in all. In some individuals development of the body outruns that of mind and morals, or *vice versa*. In similar manner, development of different portions of the body may lead to disharmony with other parts, for example, the teeth may be too large for the jaws, or fat too great a load for heart and muscles. The ideal physical condition is one in which there is harmonious development of all parts of the body. In like manner, the ideal mental and moral condition is that in which there is coordinated and harmonious development of the physical, intellectual, and social aspects of human nature.

The view is widely held that progress in body, mind, and morals will go on forever, or at least as long as the human

species shall endure. But, while many improvements in each of these lines are possible and practicable, there are limits beyond which the development of particular forms and functions cannot go. Erect posture can go no further than the vertical, hands cannot become more free for general uses than they are at present, the size of head and brain in relation to that of body cannot become much larger without making normal birth impossible and destroying the harmonious correlation of parts.

In spite of some individual exceptions, there is in general a positive correlation between cranial and intellectual capacity, larger brains being generally associated with larger intelligence. But there has been no significant increase in the size of the head and probably no increase in intellectual capacity since the Cro-Magnons. Of course there has been a vast increase in knowledge, but it is necessary to distinguish between number of things known and capacity to know. The schoolboy of today knows more things than Solomon did; Socrates, Plato, Aristotle would not be able to pass the present entrance examinations to college on the knowledge that they had, but does anyone suppose that they would be incapable of learning all that a Freshman knows or that they would be unable to finish the courses and to graduate along with the "wise old Seniors." There is no good evidence that there has been any notable advance in the intellectual capacity of man since the time of the ancient Greeks or Sumarians or Cro-Magnons. And what evidence can be brought in support of the belief in the everlasting increase in intellectual capacity?

The course of evolution in past ages shows that progress in any particular line sooner or later reaches a limit beyond which it can go no further without destroying the balance upon which all life depends. Dinosaurs and titanotheres

became extinct when giant size and enormous armor became a handicap. The giraffe has attained such a length of neck and legs that it can drink or eat from the ground only with difficulty. Even the horse is so highly specialized in limbs, teeth, and digestive organs that it could not, without human aid, survive great changes in environment. H. G. Wells once pictured the Martians as little more than nervous systems, but on neither Mars nor Earth could nervous systems develop apart from a corresponding development of nutritional and circulatory systems. In fact, life persists by preserving external and internal balance—balance between the organism and the environment, balance among the various parts and functions within the organism. There is no likelihood that the brain of man will ever greatly overbalance his other organs, and if this should happen it would lead to overspecialization and extinction.

Of course knowledge will grow from more to more, but this will be by the process which we know so well of each generation building on the work of previous generations. This does not involve continual growth of the brain and intellect of individuals, but rather increasing cooperation between individuals. The advancement of science and invention, of agriculture, industry, commerce, of education and government, of peace and war, are all the results of cooperative efforts of men in society. This is the direction in which human progress has been going for many thousands of years, and this is the course which it is sure to follow while the present species endures.

In short, the main direction of human progress has turned from the path of further differentiation of the individual to that of increasing differentiation and integration of society. Professor C. O. Whitman once wrote, "Differentiation and integration are companion principles

of progress." But in human society differentiation has outrun integration, specialization is far in advance of cooperation. Now, for the first time in the long history of man on earth, wars and revolutions are world-wide, conflicts are totalitarian, the attempt is being made to force cooperation upon all nations by violence. Forced cooperation has often failed in the past when tried on a smaller scale, whereas the democratic process of cooperation through persuasion, education, and majority rule has measurably succeeded, notably in these United States. Is a genuine federation of the whole world possible? Evidently this is the goal toward which these world-wide conflicts are aimed. Perhaps they are the birth pangs of a new order of national and international cooperation. Surely this goal will ultimately be reached if human intelligence and the race itself survive.

5. FACTORS OF PROGRESS: NATURAL SELECTION AND ORGANIC SELECTION

As is well known, Charles Darwin concluded that natural selection, or the elimination of the unfit, is the chief but not the only factor in organic evolution. He observed that organisms vary in many directions some of which are more fitted to survive than others, and these are favored in the struggle for existence, while the less fit are eliminated. Many criticisms have been brought against this theory. Jacques Loeb once said, "Darwinism is the theory which says, 'Animals that can't live, die.' " But if there are hereditary differences between animals that can live and those that can't, this does explain the survival and perpetuation of those that can, that is, the fit. Natural selection does not create the forms which it selects, but it does guide the course of evolution, and it does offer a formal explanation of the existing fitness of organisms.

In Darwin's theory, the environment is the chief factor which eliminates the unfit; overcrowding, lack of foods, adverse climatic conditions, if sufficiently severe, lead to the death of those individuals least able to endure and to adapt themselves to the new conditions. To a certain extent all organisms have the ability of adaptation or adjustment. This is one of the fundamental characteristics of living things. In this process of individual adaptation there is no elimination of unfit persons, the organism persists throughout, making many different responses to the adverse conditions, and by a process of "trial and error," and finally trial and success, adaptation to the new conditions is attained. This process is seen most clearly in cases where adjustment is made by movement. Long ago Jennings showed that if Paramecia are placed in a trough of water, one end of which is hot and the other cold, they swim at random in many directions until they get into hot or cold water, when they back, turn into a new path, and go forward until they strike some obstacle or again come into hot or cold water, when the process of backing and turning into a new path is repeated. As a result of many such trials and errors they ultimately gather in a region somewhere between the hot and cold ends of the trough. Here is a case of beneficial adjustment to environment by means of random movements with the elimination of those movements which are not beneficial or satisfactory. It resembles natural selection except that adjustment is attained by the elimination of unfit (unsatisfactory) responses instead of unfit persons.

Multitudes of adjustments to new or adverse conditions are made in this way; indeed, it seems probable that all adjustments of individuals to novel conditions, such as acclimatization, tolerance of poisons, encystment of foreign

objects or parasites, acquired immunity, etc., are results of overproduction of responses, elimination of the useless or unfit ones, and persistence in those which are useful.

But there is one fundamental difference between natural selection and organic selection by trial and error; in the former the environment, such as heat, cold, poisons, enemies, is the eliminator; in the latter the organism itself eliminates the useless or unfit responses. This is a fundamental difference for it implies that the organism is sensitive, and is capable of differentiating between the satisfactory and the unsatisfactory, and of responding positively to the former and negatively to the latter. We shall return to this subject in the second lecture, when dealing with the development of psychic qualities. It is appropriate here to call attention to the fact that differential sensitivity of organisms represents the subjective phenomena of life reduced to their simplest terms.

No adaptation is ever perfect; it is often just good enough to pass muster; sometimes it fails, with the result that the organism perishes. Indeed death is the result of failure to make adjustment to adverse conditions. These individually acquired adaptations are frequently as perfect as inherited ones, and it is often difficult to distinguish one from the other. For example, the acquired pigmentation of the skin of white races under the influence of strong light is very similar to the inherited pigmentation of dark-skinned races; both are adaptations that protect the underlying living cells from the injurious effects of short-wave radiations. Acquired immunity to certain infections is practically indistinguishable from inherited immunity in other races. The same is true of acquired acclimatization to low or high temperatures, or to increased or decreased salinity of the water as compared with natural or inherited acclimatization. The

thickened epidermis of hands and feet which is caused by friction is essentially similar to that which is inherited. The same can be said of acquired as compared with inherited adaptations of respiration and circulation in high or low altitudes; or of acquired and inherited adaptations to the digestion of particular kinds of food; or of regenerated as compared with normal limbs of crabs and salamanders. In hundreds of such cases individually acquired adaptations are fundamentally similar to normally inherited ones, and it is difficult to resist the conclusion that the two must be genetically related.

Lamarck and his followers maintained that acquired adaptations may become inherited in the course of time and thus appear in offspring in the absence of the conditions which called them forth in ancestors. But much recent experimental work indicates that acquired characters are not inherited, and this is generally held by radical Darwinians to prove that the organism itself takes no active part in its own evolution, but is passively modified and moulded by environment. In the general functions of living things the response of the organism to environmental stimuli is the distinctive or differential factor. Can it be otherwise in the responses that lead to evolutionary changes? Whether these changes occur only in genes or chromosomes or germ cells or organisms as a whole, are they not physiological responses of living matter?

In both inherited and acquired adaptations there is overproduction of multifarious reactions (mutations and responses), elimination of the unfit or unsatisfactory, and survival (persistence) of the fit or satisfactory. The result is essentially the same whether the elimination is caused by the environment or by the organism, or by both. Such words as "fit" and "satisfactory" have a purposive and subjective

significance, and therefore they and all that they stand for are taboo with strict mechanists, but few of these "iron men" deny the fact that human beings and higher animals experience satisfactions and dissatisfactions and that they seek the former and try to avoid the latter; even lower forms of life act "as if" this were true of them.

But if individual adaptations, which have been acquired through ability to differentiate between the satisfactory and the unsatisfactory, are never inherited, there would seem to be no way in which organisms can take an active part in their own transformations; they would be mere clay in the hands of the potter, environment. Certainly there is no evidence that animals and plants exercise any *conscious* purpose in their transformations. Lamarck held that "appetency" or desire is a factor in the evolution of animals and by some this hypothesis was carried to such absurd lengths that Darwin wrote to Hooker, "Heaven forfend me from Lamarck's nonsense of . . . adaptations from the slow willing of animals!" This notion was satirized by scientists, popular writers, and even by poets. Lowell wrote in his *Biglow Papers,*

> Some filosofers think that a fakkilty's granted
> The minnit it's felt to be thoroughly wanted,
> .....
> That the fears of a monkey whose holt chanced to fail
> Drawed the vertebry out to a prehensile tail.

This Lamarckian factor of evolution has been generally discredited and abandoned; it could not be applied to lower animals and plants, if appetency is given the meaning of desire or volition. But in the sense of appetite, need, drive, urge, *élan vital,* it is a factor in the *behavior* of organisms —but not in their *evolution* unless acquired adaptations can be inherited.

Although Darwin rejected Lamarck's factor of appetency, he accepted his doctrine of the inheritance of modifications (adaptations) caused by the direct action of environment or by use or disuse. In this way Darwin supposed that the organism itself took some active part in its transformations. This conception of the cooperation of any organism in its own evolution was carried much further by Darwin in his hypothesis of sexual selection, in which the female was supposed to exercise some choice in the selection of the male. It has been shown that this psychical or aesthetic form of mate selection cannot apply to lower animals or to plants, and it has generally been discredited. But in human experience there is such a thing as mating preference, and a thorough-going evolutionist should be willing to look for its beginnings in lower forms of life. There is no doubt that there are mating preferences in many higher animals, and even in lower animals it is usually as difficult to mate different races or species as it is to get foreign sperm to enter and fertilize an egg. These sexual affinities or antagonisms are generally regarded as tropisms which are chemical in nature, and this raises the philosophical question whether psychical phenomena may not be chemical in origin, or conversely whether *elements* of the psychical may not be found in chemical phenomena. This philosophical problem cannot be dealt with here.

It seems to me probable that further study of the factors of evolution will show that differential sensitivity and reactivity, which are the psychic elements basic to feelings and intelligence, have been factors in organic evolution. But at present, in the absence of evidence of the inheritance of acquired adaptations, it is not possible to prove that organisms have taken any active part in their own evolution, that is, in the transformation of one species into another. But

at least acquired adaptations do preserve the lives of individuals, giving time for inherited adaptations to appear by multifarious mutations, as is now believed. This is the "organic selection" of Baldwin and Osborn, which might better have been called "response selection" or "intrapersonal selection" in contrast to the "personal selection" of Darwin.

At present we see human intelligence at work in the improvement of animal and plant species, we see animal intelligence and instinct active in the survival of higher animals, and differential sensitivity and reactivity as factors in the survival of every living thing. Is it unreasonable to suppose that something basic to intelligence and purpose is found in all organic evolution?

6. THE ROLE OF EUGENICS

Millions of human beings are born so defective in organization that they cannot survive and leave offspring, and although we may attempt by every means in our power to preserve them, we cannot do it. Other millions not so seriously defective we do manage to preserve, with the result that modern society is burdened with multitudes of feebleminded, epileptic, insane, deaf, blind, and deformed, some of whom, at least, transmit these defects to their children. It is because of the weakening of natural selection that the human race contains so many defectives. Galton said, "Our human stock is far more weakly through congenital imperfection than any other species of animals, whether wild or domestic."

Unquestionably this greater imperfection of modern man is the result of nullifying the law of natural selection, so far as that is possible, and of failing to replace it by intelligent human selection. Throughout the course of past evolution,

the perfecting principle by means of which animals and plants have been prevented from deterioration, and have been adapted to changing environments, has been the continual elimination of the less fit and the perpetuation of the more fit, that is, the Darwinian principle of natural selection. But by means of his intelligence and inventiveness, modern man has often succeeded in preventing the elimination of the unfit, and by the most extraordinary efforts has preserved the lives of the diseased, defective, delinquent, and insane, and has permitted them to breed as freely as they can, with the result that, whenever any of these defects are hereditary, they are passed on to future generations. Thus arise families and stocks characterized by hereditary feeble-mindedness, epilepsy, dementia, deaf-mutism, some types of blindness, haemophilia, muscular atrophy, and numerous other defects of practically every organ-system of the body.

To eliminate such defective stocks by their ruthless destruction, as occurs in nature and as was practiced in ancient Sparta, would violate our social sentiments of mercy, compassion, and charity. But the preservation of the lives of the unfit does not necessarily require that they should be permitted to leave offspring and thus to perpetuate hereditary defects. It is right and proper that society should care for those of unfortunate inheritance and thus set aside the hard rule of the elimination of the unfit, but it should replace the ruthless process of natural selection by the humane method of intelligent human selection of those who are permitted to procreate their kind. This is the program of eugenics, and although we hear less about this now than we did a few years ago, there is much evidence that it is making progress, not merely in legislation providing for the segregation or sterilization of defectives, but much more in the general and serious concern of prospective parents that

their children shall be "well born." The increasing burden of caring for defectives will surely lead to increasing efforts to protect society from this burden, and to more rational customs of preventing the propagation of hereditary defects, and thus to more scientific methods of population control.

This is a program which is already in force in many enlightened societies. Persons showing the most serious hereditary defects are in many states prevented from passing these on to offspring by segregation of the sexes in public institutions, or more rarely by sterilization. But those enthusiasts who think that a new and better race can be produced in this way do not consult reality or reckon with statistics. No breeder of domestic animals or cultivated plants would ever expect to improve his stock by such feeble methods. They are necessary to prevent further deterioration but they offer no hope of improvement.

A much more potent means of race improvement, indeed the only means of improving inherited traits, is by the positive method of breeding from the best stock. So far as the human species is concerned this is a counsel of perfection, but at least a gain would be registered if the fashion could be established in society that leaders in thought and action would be expected to have large families, and that, when they do not, it would be generally recognized that they are shirking their most important social duty or that they carry some secret hereditary defect. That such a social consciousness or fashion can be established is shown in many countries of the East, where the continuance of the family is held to be the highest social and even religious obligation, but where too little attention is paid to hereditary quality.

In the present temper of the world the human species would not be improved by the wholesale sterilization of

those persons, nations, and races that conquerors and tyrants may proscribe—even if such a thing were possible. With class, national, and racial hatreds rampant, there is no possibility that a scientific program of eugenics can be wisely enforced. Instead of intelligent mate selection and ethical education aimed at producing the best physical, mental, and moral qualities, we see at present in certain countries a return to the law of the jungle, with natural selection operating on the lowest plane of physical strength, cunning, cruelty. This is "Nature red in tooth and claw," aimed at producing "the blond beast," and with slight regard for those distinctively human and civilized qualities of reason and altruism. It is a return to conditions of savagery and barbarism which prevailed in the early history of human society, survivals of which still persist. In the modern world, competition has led to the seizing of the best parts of the earth by the most aggressive and powerful types, and the expulsion of others to the less desirable places, such as Arctic areas, desert wastes, tropical jungles, and barren mountains; or, within a single society, to slums, ghettoes, and marginal lands. It has led to the enslavement or exploitation of certain races, tribes, or classes by others, in accordance with what has been called,

> Nature's simple plan
> That those should take who have the power
> And those should keep who can.

Whether mankind can ever become really civilized is a serious question. Certainly it will not be accomplished by breeding brutes, nor, on the other hand, by eugenical sterilizations. Rather it will come, if it ever comes, by way of ethical as well as eugenical education. Of course science recognizes the importance of good environment as well as of good heredity. All that heredity contributes are genes,

factors, potentialities. These potentialities become realities only in the process of development, and development is controlled not only by genes, but also by all the environmental conditions under which genes function. Environment, no less than heredity, enters into the results of development. This is especially evident in the later development of human beings, when example, instruction, habits, the desire of approval and fellowship are potent factors in shaping character. New-fangled eugenics will never replace old-fashioned education, but each should supplement the other.

7. THE FUTURE EVOLUTION OF MAN

One of the lessons of the long perspective of past life on the earth is the probability that it will have an equally long future. When it was thought that life had only recently appeared, it was logical to conclude that it would soon end. Prophets, poets, and seers predicted the speedy end of the world. John in Patmos saw in vision the angel standing with one foot on the sea and the other on the land and swearing that time should be no longer. Peter proclaimed "The day of the Lord in which the heavens shall pass away with a great noise and the elements shall melt with fervent heat."

Scientists predicted that the end of the world, or at least the end of all life on the earth, would come with the burning out of the sun and its failure to give out light and heat. They estimated that the sun was burning up at such a rate that it could continue to give out light and heat for only a few more thousand years. Bayard Taylor, taking his cue from these scientific predictions, wrote of human survival,

> Till the sun grows cold,
> And the stars are old,
> And the leaves of the Judgment Book unfold.

Thomas Campbell's poem on "The Last Man" deeply impressed me in my youth and I recited lugubriously:

> Go, Sun, while Mercy holds me up
> On Nature's awful waste
> To drink this last and bitter cup
> Of grief that man shall taste—
> Go, tell the night that hides thy face,
> Thou saw'st the last of Adam's race
> On Earth's sepulchral clod,
> The darkening universe defy
> To quench his Immortality,
> Or shake his trust in God!

Of the coming end of the world, Byron wrote:

> I had a dream which was not all a dream.
> The bright sun was extinguished, and the stars
> Did wander darkling in the eternal space,
> Rayless, and pathless, and the icy Earth
> Swung blind and blackening in the moonless air;
> Morn came and went—and came, and brought no day,
> And men forgot their passions in the dread
> Of this their desolation; and all hearts
> Were chilled into a selfish prayer for light.

One hundred years ago, in 1841, William Miller, a religious leader of Low Hampton, N. Y., predicted the second coming of Christ in 1843 to take with him to Heaven the souls and bodies of all the righteous and to cause the earth to dissolve in fervent heat. So profound was the effect of his preaching that it produced "the temporary insanity of hundreds of thousands of his followers" and filled the hospitals for mental diseases. The first volume of the *American Journal of Insanity* spoke of Millerism as being "as bad as an epidemic of cholera or yellow fever." Millerites assembled, on the day appointed, in their ascension robes of white sheets and sometimes with their most precious possessions strapped to their backs, and waited for the sound of the trump of the Archangel announcing "the end of all things mortal." When that day came and went without the

expected event, it was said that a mistake had been made in the date and a new date was set for "the end of the world." I can remember groups of Millerites and Second Adventists some sixty years ago, who were still waiting for "the end of the world," though their ascension robes were worn rather shamefacedly. A few years ago a new prophet of the end of the world arose in Pastor Russell. He was less definite about the exact date of the catastrophe than was Miller, but it would be very soon. His followers left many signs along the roadsides in this country reading, "Many now living will never die. Prepare to meet thy God for the end is at hand."

Contrast all these expectations of the burning out of the sun and the speedy end of the world with the modern view of the incalculable stores of atomic energy in the sun and the unimaginably long time, about ten billion years (Bethe), before it shall fail to light and heat the earth so that it will continue to bring forth seed time and harvest. Contrast this short view of life and of human history with the long view which science now reveals. There is every good reason to think that the future of the earth and solar system will be as long as the past, and that the clock of life on earth will go on for at least another twelve hours, of a hundred million years each, from high noon to midnight.

What the course of organic evolution will be in these coming millennia no one can foresee. The student of evolution knows that its course has not always been forward, there have been many back currents and eddies in the stream of life; many puissant and promising types have appeared, and for a time have dominated the earth, only later to undergo regression, decay, and extinction. Giant cephalopods and fishes were the terrors of paleozoic seas; enormous reptiles dominated the land, the water, and the

air; the tread of titanosaurs and titanotheres shook the ground; gigantic birds and beasts flourished, whose modern representatives are but faint echoes of their mighty predecessors.

Every thoughtful evolutionist must have asked himself whether the human species may not, like a multitude of other species, reach a climax and then go down and become extinct. Nature plays no favorites in the struggle for existence and she will make no exception in favor of man. It is generally supposed that extinction of species in the past has been caused by adverse conditions or overspecialization. Extinction within the historic era has often been caused by man or by changes in environment. But unless a species is peculiarly localized in distribution and uniform in organization, it is not exterminated *en masse;* rather it is eliminated piecemeal, one local variety or breed after another failing to perpetuate itself, until the entire species becomes extinct. The human species is so widely distributed over the earth, and is so lacking in uniformity of organization, that it is practically certain that, barring some astronomical or geological cataclysm, it will never be destroyed *en masse.* On the contrary, it is probable that decline and decay will creep gradually over families and stocks, subraces and races, leaving more viable and virile lines untouched. This is precisely what is happening throughout the world today. Some families and subraces are declining and disappearing while others are flourishing and increasing.

In countless ways man is taking part in his own transformations not only by such destructive processes as dysgenics, voluntary sterility, racial and social conflicts, and the mass murders of modern wars, but also in the beneficial results of modern medicine and sanitation, education and eugenics, social organization and ameliorization, and the struggle for

higher ideals of ethics, aesthetics, and religion. Intelligent purpose has become an important factor in human progress but not necessarily in the production of a new species. There are many reasons for thinking that man may never by his own efforts produce a higher species than *Homo sapiens*. In the past, new species have arisen through the appearance of new mutations that were better fitted to conditions of existence than the parent stocks, which they then gradually replaced. But the fact that man is able to so large an extent to control his environment reduces the importance of this cause of evolution. Some human families and stocks are more fertile and resistant to disease than others, and they may well replace the less fertile and less viable, but, since all existing human races belong to one and the same species, this would not in itself give rise to a new species, though it would favor certain races and possibly eliminate others, and might in the course of long millennia lead to the elimination of all but a single race.

Intelligence and social cooperation make it possible for man to take a conscious part in race improvement by choosing desirable types for propagation and by eliminating the undesirable. No doubt hereditary variations or mutations occur, and will continue to occur in the human species, and the future may reveal methods by which they may be increased. The vast majority of mutations are less perfect and less viable than the normal stocks from which they come, but, assuming that beneficial mutations may occur in the human stock, what ground is there for supposing that their selection for perpetuation would lead to a new species? In so far as intelligent selection replaces natural selection in the breeding of men, ideals of perfection become factors in the production of the future race, and such ideals of men have always been and will probably always

remain specifically human and even racially limited. Members of the white race cannot now conceive of more perfect bodily forms than the Apollo Belvedere and the Venus de Milo; other races, other times may have different ideals, but they will probably always be human. The highest ideals of poets and seers are of a more perfect man, not of some other, even though higher, species. Whittier wrote of

> A dream of man and woman
> Diviner but *still human,*
> Solving the riddle old,
> Shaping the age of gold.

Scientific and humanistic prophets have often pictured a future Utopia with "men like gods," and religious prophets have pictured a future heaven like a garden or a city with god-like men, endowed with human forms and attributes but free from human imperfections and limitations. To the extent, therefore, that man can realize his highest ideals and actually become master of his destiny, it does not seem probable that he will purposively give rise to some other species. But if the species persists, and knowledge increases, progress will continue toward the goals thought most desirable.

There is abundant evidence that existing races and subraces are mingling and becoming less distinct. Geographical isolation which was an important factor in the establishment of existing races has largely disappeared under modern systems of transportation and communication. Now all races can, and to a certain extent do, interbreed, and in many parts of the world extensive hybridization is going on. There are very few, if any, really pure human races; from the standpoint of a breeder of pure stock man is hopelessly mongrelized. What the ultimate effect of this mingling of races may be is impossible to predict. Hybrids are mosaics of the characteristics of their parents; they may combine

many of the bad traits of both parents, or a majority of the good traits, and in the latter case they are better than either of the parent stocks. It is scientifically possible to produce a superior race by hybridization and the selection through many generations of the best of the offspring, but in the case of man this is at present impracticable socially.

Other changes in racial constitution are being wrought by differences in the relative fecundity and mortality of different stocks; this is one of the most important factors both in preservation and extinction of different human types. The causes of human sterility are twofold, biological and social, or involuntary and voluntary. The former are constitutional and of deep-seated nature, the latter are superficial and could be changed by changes in ideals and social customs. Biological causes of the extinction of certain families may be found in too close inbreeding of stocks carrying in their heredity certain lethal factors which destroy germ cells or embryos or individuals before they reach maturity. Such cases are found in certain royal and noble families which have had every reason to desire to perpetuate their lines, but nevertheless became extinct. Thus Fahlenbeck found that 433 noble families of Sweden had become extinct in the male line. Broman has shown that in most of the noble families of Europe the direct male line, and with it the family name, dies out in the course of from 100 to 250 years. Similar observations have been made regarding the families of great scholars, artists, statesmen, and men of distinction. It is highly probable that in most of these instances the causes of extinction are not voluntary and purposive ones.

A widespread cause of sterility and extinction is found in voluntary childlessness. With relatively rare exceptions, normal men desire to prolong their individual lives and to perpetuate their kind, and yet there are some persons who

cling tenaciously to life here, and hope for immortal life hereafter, and yet deliberately commit race suicide. This suicidal tendency is much stronger in some times and places than in others, but, wherever it prevails, it leads to a rapid extinction of the stock concerned. Throughout many populous countries of the orient there often seems to be less regard for the preservation of the individual than for the perpetuation of the family. In many occidental countries we find the exact reverse of this, namely, a deep concern for the prolongation of individual lives and a callous disregard for the continuance of the family. In the orient generally parents boast of the large number of their children, and are congratulated and envied because of this; in the occident they are often ashamed of a large family, and are commiserated or socially ostracised on this account. In the East the most honorable salutation that can be addressed to a woman is, "May you be the mother of many sons." The cry of Rachel, "Give me children or I die," is echoed in reverse by many emancipated women of the West, "I'd rather die than have children." There are many ways of committing suicide, but the most effective method of mass suicide is not by spreading wars, pestilences, or famines, but by promoting voluntary sterility.

In one of his facetious but really deeply serious addresses, Harlow Shapley canvassed the various possible ways by which the present stupid, wicked, irrational human species might be exterminated and a new start made from some other source. He showed that astronomy and geology offered little hope of an all-exterminating world catastrophe; that biology had little to offer now, since animal and plant predators and parasites and the most destructive human pestilences have been so largely brought under control; but that man himself controlled the only feasible means of his own complete extermination.

But there is no probability that this will happen while other species of higher animals are left on earth; no probability that from any other species or order or class of animals a new cycle of evolution will lead to another type of animal more perfect in body, mind, and social organization than the human species. If such a more perfect creature is ever to develop it must probably be from *Homo sapiens.* Clarence Day in his humorous book, *This Simian World,* speculated on what evolution might have led to if cats or birds or other classes of animals had been the ancestral stock, rather than monkeys. But there is no other existing species of higher animal capable of taking the dominant place which man has occupied, no other capable of giving rise to the intellectual and spiritual development which man has attained. Even the anthropoid apes would offer no prospect of success. At the close of the World War of 1914–18, the German humorous paper, *Simplizissimus* printed a cartoon showing a forlorn old chimpanzee in a shell-torn tree on a battlefield covered with the corpses of the human race, and saying sadly, "Now it must all be done over again." But evolution cannot be done over again from existing species of higher animals. If progress in the direction of greater reason and ethics is to go on, it must be from human stock, and if more perfect species than *Homo sapiens* should evolve in the countless ages of the future, it will probably not be as a result of conscious human purpose, but rather, as in the past, in connection with great secular changes over which man has no control, such as the rising and sinking of continents, the formation of deserts or mountains or oceans, or changes in climate comparable to the glacial and interglacial epochs, during which human evolution made such wonderful progress. Man is the last, best hope of future evolutionary progress in body, mind, and society.

II

THE DEVELOPMENT OF THE INDIVIDUAL

IT is not necessary to explore what Shakespeare called "the dark backward and abysm of time" in order to see man in the process of his becoming. Evolution or phylogeny helps us to see him in proper perspective against the immensity of time and space and the vast processes of life on the earth, but for close and accurate observation the development of the individual or ontogeny offers opportunities for exact and even experimental study that can never be equalled by any exploration of the course of evolution in past ages of the earth's history.

In the development of the individual we can see and study the exact stages of such becoming, and the causes or factors that are involved. These factors of development are of two general classes, those that lie within the organism and those that come from outside; in the main, the former are known as heredity, the latter as environment, or in "the jingle of words" proposed by Francis Galton, they are Nature and Nurture. The former of these factors of development are found in the constitution of the germ cells from which every individual develops, the latter in the conditions and stimuli which act upon this germinal organization in the course of its transformation into the mature organism.

1. THE AMAZING FACTS OF DEVELOPMENT

It is a curious and interesting fact that philosophers generally consider man only in the full epiphany of his powers,

and forget or disregard the steps by which he has reached this high estate. And yet nothing is more universally evident than the process of development. Every person in the world, indeed, every animal and plant except possibly the very lowest, has come into existence by this method of development. I never see a great crowd of people without thinking that each and every one of them was once a child, an infant, an embryo, an egg cell—that every human being was born of woman. A professor of gynecology in one of our medical schools used to hold up before his classes the skeleton of a female pelvis and say, "Gentlemen, here is the triumphal arch through which every mother's son has come into the world." We generally think of illustrious persons as if they had always been illustrious, forgetting that every one of them was once a child and thought as a child, and before that a baby, an embryo, a germ cell, and behaved as a baby, an embryo, and a germ cell.

The mere fact of such development is so marvellous that it would seem incredible were it not so universally evident. The development of a human being, of a great personality, from a germ cell is surely the climax of all wonders, and yet it is so common that it has ceased to excite wonder. The principal steps or stages of development are known for thousands of species of animals and plants and enough is known of human development to be certain that in all essential respects it resembles that of other animals and especially that of higher mammals. We know that the entire person—structures and functions, organs and their uses, sense organs and nervous system, tropisms and instincts, sensations and emotions, memory and intelligence—in short, all physical and psychical characteristics, are the products of development. Furthermore, structures and functions, body and mind, develop together as a single indivisible unity.

This is a conclusion of such vast philosophical importance that it cannot be overemphasized. There is no possibility of denying the reality of such development, and the very fact that psychical qualities as well as physical ones develop out of a germinal condition will, if squarely faced, upset whole systems of philosophy and theology.

2. THEORIES OF DEVELOPMENT

When the disturbing implications of personal development began to be appreciated in the eighteenth century there arose a school of naturalist-philosophers who attempted to solve all of these difficulties by denying the fact of development. "There is no becoming," said the physiologist Haller, all things being present in miniature in the germ. What seemed like development was said to be only growth and unfolding or "evolutio." The little plant, root and stem and leaves, could be seen in the seed, and with poor microscopes and good imaginations it was said that the little man, the "homunculus," head and limbs and all, could be seen in the human sperm; and finally it was maintained that generation inside generation to the end of the species was packed away in the germ cells of the first parents.

This absurd and impossible conclusion was challenged and finally overthrown by an appeal to the actual development of the germ. Caspar Friedrich Wolff, in 1759, showed that in the earliest stages of seeds and eggs there was no little plant or animal, but only semi-fluid globules (cells) which gradually took the form of layers, membranes, and organs. Development in the sense of transformation and new formation was therefore a fact, and was something more than the mere unfolding of a preformed organism. Indeed, it was assumed that at the beginning of development the germ was absolutely simple, if not unorganized, and

that mysterious formative and directive forces (*"nisus formativus"* and *"vis directrix"*) acted upon the germ and caused it to develop in a specific way. Thus development was, as it were, built on the germ from without, and therefore this theory was called *epigenesis*. The old view of preformation assumed genesis from within and might therefore be called *endogenesis*.

There is no doubt that epigenesis more nearly corresponds to the facts of development than preformation, but there are elements of truth in both of these theories, and errors in the extreme views of each. The germ is not a mature animal in miniature, nor is it wholly lacking in substances and parts that guide and direct development. The complex egg cell is transformed into the still more complex adult by environmental stimuli acting on its intrinsic constitution; both epigenesis and endogenesis are involved in development.

Development is a fact, both body and mind develop, and this fact must be reckoned with by all present systems of philosophy. Although body and mind develop together, all structures and functions do not develop at the same rate; some come to maturity early, others late, and all succeeding stages are influenced by, and dependent on, preceding ones. Some structures and functions are of only temporary value, and then give way to, or are transformed into, parts and functions of more lasting service, until the final adult structures and functions are attained. But, at every step, structure and function are inseparable in any living thing, every living structure has its function, every function its structure at every stage in development.

Although structure and function, body and mind, develop together, it will be convenient to deal with them separately, and we begin with the development of the body. In all ani-

mals and plants development begins in a single cell, the egg or female sex cell. It was once thought that this cell was very simple, a mere mass of mucus, mucilage, or living jelly. Even as late as 1874, the distinguished German embryologist, Alexander Goette, maintained that the egg of the toad "is neither in whole nor in part a living organism," but is a mass of non-living material which is stimulated into life by the entrance of the spermatozoon.[1] At the beginning of this century the work of Jacques Loeb on "chemical fertilization," or what is now called artificial parthenogenesis, led many persons to conclude that the egg became alive under the action of salt solutions. Of course such conclusions were absurd. Eggs are as truly alive as are mature animals. But although they are as truly alive, they are not as complexly alive, but are relatively simple as compared with adults. In the egg cell from which a man develops we have human life reduced to its simplest terms, and it is because life structures and functions are here reduced to their simplest terms that the study of the egg and its development is so fascinating.

3. THE MECHANISM OF DIFFERENTIATION

Every cell, whether egg or sperm or tissue cell, consists of at least two distinct portions, a central body, the nucleus, and the surrounding cell substance, or cytoplasm. Each of these consists of several different parts only a few of which need be mentioned here. Both nucleus and cytoplasm are differentiations of protoplasm, the living substance; but in addition to this living, or formative material, there are many other substances in the cell that are not living in the same sense or degree as protoplasm, for there are various stages or degrees of living. These other substances are

[1] A. Goette, *Entwicklungs Geschichte der Unke,* pp. 35, 77.

called collectively metaplasm, and many different kinds of metaplasm are formed in the course of development.

The nucleus is a compound structure consisting of a specific number of chromosomal vesicles which form compartments or segments of the whole nucleus. At the time of cell division, within each compartment arises a long thread or chromosome with a series of granules or chromomeres along the thread, like beads on a string. In the division of the nucleus and cell, each chromosome with its chromomeres splits lengthwise, the two halves separating to the two daughter cells, so that there is an exact halving of every chromosome and chromomere in this process of division, which is called mitosis.

This complicated method of division indicates that the chromosomes must be of great importance, and extensive study has shown that they are the seat of specific factors of heredity. Furthermore the remarkable work of Morgan and his associates has proved that these specific factors of heredity have definite locations along the length of each chromosome, similar to, but more numerous than, the chromomeres. These factors have been called genes, and there has been much speculation as to what they are and how they act, but at least it can be said that they are specific factors in the determination of particular hereditary characteristics, such as blue or brown eyes, curly or straight hair, etc.

Chromosomes and genes usually continue without fundamental change throughout all cell divisions, so that in the end every cell in the body may have the same constellation of chromosomes and genes. And yet these cells have become amazingly dissimilar; some are epithelia, glands, nerves, muscles, cartilage, bone, etc. How is it possible to explain this progressive cell differentiation when there is no pro-

gressive nuclear differentiation? Well, we know that while the nucleus always divides with exact equality, the cell body often divides very unequally. The cell body contains a variety of different substances, which are more or less localized in different parts of the cell, and, when the cell body divides, these substances often go into different daughter cells. Thus differences, or differentiations, arise among embryonic cells.

But in order to account for the amazing number of differentiations in the body of any animal, there must be a progressive *production* of different kinds of substances in the cell bodies as well as a differential *distribution* of these substances to the cells in division. How are these different substances produced, and how does heredity, that is how do the chromosomes, control this process of differentiation?

There is a continual interchange between the nucleus and the cell body. When the chromosomes are dividing, they are small, dense threads. Immediately after division they swell up by absorbing fluid from the cell body and become chromosomal vesicles, and all these vesicles crowded together make the spherical nucleus, which continues to absorb fluid from the cell body until the division stage is reached, when the nuclear membrane and the chromosomal vesicles dissolve, liberating the new chromosomes naked into the cell body, and at the same time setting free a large volume of granular fluid into the cytoplasm. In the cycle from one cell division to the next there is thus a period during which the chromosomes and chromosomal vesicles are taking in fluids by osmosis, and a period when by the dissolution of their membranes they set free into the cytoplasm large quantities of elaborated materials. These periods may be called the "diastole" and "systole" of the nucleus, and within the framework of this mechanism the hereditary control of differentiation takes place. It is not possible at

present to follow all the details of this process, but its general outlines are clearly marked.

All differentiation occurs in the cell body, while the nucleus and genes do not undergo progressive differentiation in the course of development, but remain relatively unchanged throughout the whole life cycle. The nucleus with its chromosomes and genes is therefore the chief seat of the material basis of heredity; the cell body is the place where differentiation occurs.

The earliest differentiations of egg cells are relatively few but very fundamental. Even while the egg is growing in the ovary, there is usually a difference in the relative quantities of cytoplasm and yolk at the two poles on opposite sides of the egg. The axis connecting these poles is the chief axis, and it bears a definite relation to the chief axis of the body that develops from the egg. In some types of eggs bilateral symmetry or asymmetry is visible, and these become the bilaterality or asymmetry of the adult. Even the positions and proportions of some of the future organ systems, such as muscles, nervous system, notochord, gut, may be marked out in the egg by different kinds of cytoplasm. These different substances and their locations in the egg cell are the earliest visible differentiations of development.

Different phyla of animals have different types of eggs; for example, there are the echinoderm, the annelid, the molluscan, and the vertebrate types. Development begins and certain main features are determined in the egg before it is fertilized. Consequently the egg contributes more to development than the sperm does.

We are vertebrates because our mothers were vertebrates and produced eggs of the vertebrate type; but the color of our skin and hair and eyes, our sex, stature and mental peculiarities were determined by the sperm as well as by the egg from which we came.[1]

[1]Conklin, *Heredity and Environment,* Princeton University Press, 1915.

In most animals and plants the progressive differentiation of the egg ceases at an early stage unless it is entered and fertilized by a male sex cell or sperm. The sperm not only stimulates the egg to go on in its development, but it also brings into the egg a new group of chromosomes and their genes. Just as the differentiations of the egg before fertilization are controlled by genes in the egg nucleus, so the genes of both egg and sperm nuclei influence later differentiations after fertilization. The manner in which this influence of genes on cytoplasm is accomplished is not certainly known, but it seems probable that it is by means of certain enzymes or ferments which are formed by the genes and which then act on the cytoplasm to cause differentiations. Here is in bare outline the mechanism or machinery by which the hereditary factors, the genes, influence the cytoplasm of the egg so as to bring about the differentiations of development.

There are certain resemblances between the fundamental processes in the ontogeny and phylogeny of organisms and those involved in inorganic and cosmic evolution. All of these phenomena are forms of development, and in all there is the production of new substances and qualities, new structures and functions, by means of new combinations of pre-existing elements or units. So far as is now known, all the material substances in the universe are the products of different combinations of some ninety-two different kinds of chemical elements or atoms. Thus a relatively small number of different kinds of atoms gives rise to an inconceivably large number of different kinds of compounds. We have recently learned that the ninety-two different kinds of atoms are products of different combinations of a few identically similar protons, electrons, and possibly other subatomic units. In similar manner, different combinations

of twenty-six letters of the alphabet produce an immense number of words, and different combinations of words give rise to whole literatures.

In each of these combinations of units, new qualities appear which were not present in the individual units, but are the results of the new combinations. The peculiar characteristics of the ninety-two different kinds of atoms, from the simplest, hydrogen, to the most complex, uranium, are not present in the protons and electrons, but result from ninety-two different combinations of these. The properties of the innumerable different chemical compounds in the universe are not present in the individual atoms and molecules that enter into their constitution, but are products of the innumerable combinations of these atoms and molecules. The homunculus does not exist already preformed in the germ cells, but the embryo results from the interaction of genes and cytoplasm, of cells and environments. Mind and consciousness are not present in the germ cells, but they are the new products of innumerable structures and functions that are differentiated and integrated in the course of development. The literatures of the world are not found in the individual words of which they are composed, nor the words in the individual letters, but always new characteristics appear in new combinations of units which do not show these qualities.

This general principle has been called "creative synthesis" (Spaulding), "creative evolution" (Bergson), "emergence" (Lloyd Morgan), and it is fundamental in all development, whether of an individual or a species. New combinations of atoms and molecules give rise to new kinds of genes and chromosomes and cytoplasms. New combinations of nuclear and cytoplasmic substances give rise to the innumerable kinds of substances formed in the process of differ-

entiation. Development is not a mere additive process, but a creative one. But typical development consists not only in the formation of new substances with new qualities, but also in the orderly localization and integration of these in the embryo. These localizations are brought about by flowing movements in the protoplasm by which different substances are carried to particular parts of the egg cell, and by means of cell division these substances are cut off in different cells. Different kinds of cells unite to form tissues, tissues to form organs, organs to form systems, and all these constitute the organism.

All these processes of differentiation, localization, and segregation of different substances, cells, and organs would result in dislocated or isolated organs and portions of the body if it were not for some principle of integration. This integration is secured at first by actual contact between different substances and structures within cells, and later by contact and interchange between different cells, but, as the number of cells and parts increases, the various parts are integrated by specialized nerve cells which connect all parts together; also by peculiar chemical substances, the hormones, which are formed in specialized and localized glands and are then distributed to all portions of the organism, where they serve to stimulate the activity of certain cells or to restrict the activity of others, and thus to preserve the integration of the organism. Much experimental work is being done on the integrations of development and the unity of the organism, but it is still a good deal of a mystery. We can understand some of its main features, but not its most significant details, e. g., it is clear that the contacts of cells, the connections of nerves, or the distribution of hormones provide the means for stimulation or inhibition, but how and why they act upon those particular cells where

stimulus or inhibition is needed in order to control typical development—this is the mystery.

4. STRUCTURE AND FUNCTION

There can be no doubt that the fundamental causes of development, as well as its general course, are essentially the same in man and animals. This is true not only of bodily structures but also of functions or the uses of structures. Just as certain fundamental structures are present in the egg at the beginning of development, so also certain fundamental functions are present. Indeed, the egg is a living thing, and it has all the necessary functions of living things. First among these is the function of assimilation, or the capacity of converting certain foreign substances into its own substance, which power every living thing possesses. Everywhere the continuance of life depends upon assimilation, for the complex living material is continually being oxidized to less complex substances, and it would quickly be used up if it were not replaced by the incorporation of new material. Living always involves this oxidation or burning. "The flame of life" is no mere figure of speech; if it produced visible light we would all be shining beacons. The persistence, growth, and spread of living things depend first of all upon the capacity of living material to build foreign substance into its own substance. This is assimilation (making similar) of foreign substances to the living material.

As a result of assimilation, living matter grows, but never as one continuous mass, but rather as discontinuous masses, or individual units. The units of living matter which are found everywhere are cells, each of which grows to a certain maximal size and then divides, or ceases to continue to grow. In the same way, nuclei, chromosomes, genes have

the capacity of individual assimilation, growth, and division, and the same is true of certain units in the cytoplasm of cells. Indeed, assimilation, growth, and division are fundamental properties of all living units, and there is no better answer than this to the question, "Is this alive?" or to that more general question, "What is life?"

Other properties of living things, which are not always so evident, are often lumped together under the term irritability. But many non-living things are also irritable, that is, they respond to stimuli, as gunpowder responds to a spark, or the photographic plate to light. The irritability of living things is peculiar in that the responses to stimuli differ with different conditions, and especially because such responses are generally useful in that they are self-conserving. This irritability of living matter might better be called "differential sensitivity," and the usefulness of a response, "selective reactivity," for the organism appears to select from many possible responses those which tend to its self-preservation.

All of these basic functions are found in eggs and sperms as well as in other kinds of living cells; they are as characteristic of life as are the structures of protoplasm and cells; indeed they are more characteristic because they are more generally recognized. The usual method of determining whether an object is alive or not is by observing what it does —its functions rather than its structures. But functions and structures are inseparable in living things; they are merely two aspects of life, and may be compared with the two sides of a coin. Function is not the cause of structure, or *vice versa,* any more than one side of a coin is the cause of the other side; they are in fact two aspects of one thing.

One reason why this has not always been appreciated is the fact that the structures of a dead body seem to remain

after the functions have ceased, but the structures of a dead body are not like the living structures. A large part of our bodies is not living, while other parts are alive; hair, nails, the outer skin, much of our teeth and bones and the larger part of the connective tissue which penetrates and binds together the various organs, are not really or fully alive. Only that relatively small part, the protoplasm of the living cells, is fully alive, and when death occurs it undergoes profound changes. Dead protoplasm does not have the same structure as living protoplasm; it undergoes coagulation and disorganization, and ceases to manifest the functions of living protoplasm. Thus structure and function are inseparable in living beings; where there are no living structures, there are no living functions, and *vice versa*. Furthermore, specific living functions are always associated with specific forms of protoplasm; the protoplasm of a gland or muscle or nerve cell is as specific as the functions of those cells, although it may not be so plainly visible. No postulate of biology is more certain than this, that the functions of life are inseparably associated with the structures of living matter.

This is a conclusion of the utmost importance in biology and philosophy. It does not mean that structure is the cause of function, nor that function is the cause of structure, but that in life neither can exist apart from the other. Probably no scientist or philosopher would deny that digestion is associated with the secretion of digestive cells, motion with the contraction of muscle cells, nerve reception and conduction with the structure of nerve cells, and sensory phenomena with sensory cells. But materialists regard these cells as the causes of these functions, while vitalists regard the functions as in some way independent of the structures, or even the remote causes of the structures. Neither of these

conclusions is justified by scientific evidence, for in the living state there are no functions without structures, nor structures without functions. When one undergoes change, so does the other. Use or disuse of a muscle is immediately associated with changes in its structure, but neither can be said to be the cause of the other.

It is when we come to consider the relations of structures and functions in the nervous system of man that this conclusion becomes most important and even revolutionary, for it means that there can be no touch or taste or hearing or vision without corresponding sensory protoplasm or sense organs, no protoplasmic or organic memory without the registry of certain changes in the protoplasm of cells, no associative memory without association tracts, no consciousness without the complicated reactions and interactions of many brain cells and their connections. And yet this does not signify that eyes precede and are the cause of vision, nor, on the other hand, that vision exists apart from eyes. It does not mean that the nervous mechanism is the cause of consciousness, nor that consciousness exists independently of the nervous system. But it does mean that they are indissolubly united.

This is the body-mind problem, or the relations and connections between mind and body. I am aware of the fact that this is a field which has been hallowed by the labors of hundreds of the world's greatest philosophers and scientists, and I can bring no original solution to this time-honored problem. But I can at least state an honest conviction, based upon an enormous volume of the work of investigators in biology, physiology, and psychology. So far as I am aware, no modern scientist has found any conclusive evidence of the existence of a mind apart from a body, no really satisfactory evidence of disembodied spirits,

no scientific evidence in favor of Plato's conception that the relation of the soul to the body is that of the rower to his boat, or of the harpist to his harp. On the contrary, the most careful and detailed work in physiology and psychology shows that the relation between mind and body is that between function and structure. How else is it possible to interpret the facts of brain physiology, pathology, and experimental psychology? How else is it possible to interpret the facts of the parallel development and decay of body and mind?

5. INCREASE IN COMPLEXITY AND INCREASE IN EFFICIENCY

In the course of development, the generalized structures and functions of the egg become more and more specialized. Certain cells are specialized for digestion, others for motion, and still others for respiration, excretion, reproduction, and sensation, but every cell retains a residual trace of all these functions, which were present in the original egg cell and which are necessary to the life of every cell.

Groups of specialized cells form tissues and organs and systems which are able to perform specific functions better than individual cells. Thus differentiation of functions, as well as of structures, grows more complete and perfect as development progresses. This process of progressive differentiation consists in part in a separation and segregation into different cells of the general structures and functions of the egg, but mainly it is an actual increase or generation of specific structures and functions by the process of "creative synthesis" or "emergence." The egg in its development is not a self-contained and independent mechanism, and it would never undergo development except in response to environmental stimuli. These stimuli and the responses

they call forth modify the protoplasm, and these modifications enter into the actual structure and function of the developing organism, and so give rise to the increasing complexity of structures and functions.

But, while these processes would account for increasing complexity, they do not in themselves explain increasing perfection of structure and function, for mere complexity does not necessarily mean perfection. For example, perfection of vision means the efficiency with which visual organs receive and transmit to the central nervous system the stimuli coming from light rays. The compound eyes of arthropods are in many respects more complex than the eyes of vertebrates, but they are less efficient visual organs, as both physiology and physical optics testify. To explain increasing efficiency of vision, or of any other structure and function, in both ontogeny and phylogeny, it is necessary to recognize that there are ends to be attained, and that there are means or processes that direct development toward these ends.

Indeed, the moment we enter the living world, we enter a world of ends as well as of means, of finalism as well as of mechanism. So far as the physicist or chemist or astronomer can see, it makes no difference to an individual atom or molecule or planet or sun whether it continues to exist as such or not. But the biologist sees evidence that it apparently makes a difference to any living thing whether it continues to live or not. The great and universal end of living things is to continue to live, and numerous structures and functions are directed to this end. Indeed, the urge to live, the struggle for existence, is one of the most evident and universal phenomena of life. Apparently it is true of living things in general that,

> 'Tis life not death for which they pant,
> More life and fuller that they want.

In the attainment of these ends, efficiency of structures and functions are means, and in turn the perfecting of these means becomes ends. Indeed, we cannot deal with organisms logically without regarding them teleologically; in them we find both means and ends, mechanism and finalism.

It is one of the curiosities of modern biology that it goes to such extraordinary lengths to eliminate the idea of ends or purpose in the structures and functions of living things and even to deny them in the conscious experiences of human beings. It is sometimes held that words such as "ends," "purpose," "meaning," must never be used in science, and yet it is impossible to describe organisms fully without using these or other words that mean the same thing; many biologists get around this difficulty by inclosing such words in quotation marks, others speak of the "significance" or "import" or "tendency" of certain functions or processes, but by none of these verbal subterfuges are they able to get rid of the idea which lies back of all of them.

The fact is that organisms are fundamentally teleological, and although it may be impossible to explain this in a mechanistic or causal manner, this failure is no excuse for denying the reality of the phenomenon itself. It has been argued that ends exist only in the minds of intelligent observers, but the same could be said with equal cogency of means, causality, order, or nature itself. This is the view of radical philosophical idealism, but it is contrary to the fundamental concepts of objective science.

In commenting upon the fact that adaptations are mechanisms for securing the persistence of organisms, Roux[1] says: "Persistence is not an *aim* of living things but an indispensably necessary *condition*. Life cannot suddenly arise anew, but if it exists it must be preserved, and so must before all be capable of persisting, otherwise it disappears.

[1] *Arch. Entwick. Mech.* Bd. 26 (1908).

This is no *aim* but a direct necessity of its existence." But, after all, the real question is how living things are able to meet these necessary conditions of life. It may be granted that adaptations are not caused by conscious aims or purposes, but their results are much the same as if they were; they do attain certain desirable ends, and to this extent they are purposive.[1]

Denial of ends or objectives in lower organisms must logically lead to its denial in man, if the main postulate of evolution be true, namely, that all life is fundamentally one. These ends or objectives are seen in the structures and functions of human germ cells, embryos, and adults, as well as in those of lower animals. The development of organs for future uses is not accompanied by conscious purpose, but it is none the less purposive. Who can witness the development of eyes which takes place in mammals in the absence of light, or the development of a hundred other organs for some future use, without recognizing that there are objectives toward which development is directed? If objectives exist only in the mind of the observer, then what ground is there for supposing that the mind of the observer or the observer himself has any real existence? Such views lead to intellectual nihilism.

The Darwinian principle of natural selection, or the elimination of the unfit and the "preservation of favored races in the struggle for existence," has been generally recognized as a purely mechanistic explanation of increasing efficiency or fitness in the course of evolution. This principle operates by the elimination of unfit individuals and races and the survival of the more efficient ones. It is merely a sieve to sort out individuals with favorable variations or muta-

[1]E. G. Conklin, "Problems of Organic Adaptation," *Rice Institute Pamphlet*, Vol. 8, No. 4, Oct. 1921, pp. 365–366.

tions from those with unfavorable ones, and given a continual supply of the former and a sufficiently thorough sifting, the less fit will be eliminated and the more fit will survive. This principle is purely mechanistic only in so far as it operates with no ends in view. But, from the standpoint of the organism, there is always to be considered the end of survival and increasing efficiency, and natural selection is merely a means to this end.

Darwin applied this principle to the increasing fitness of organisms to their environment in the course of evolution; but there are many such fitnesses which occur in the course of individual development, as well as in the mature organism, where there is no elimination of unfit individuals. Every embryo and every adult makes many adjustments to changing conditions which tend to its survival and greater efficiency, but which are accomplished without the elimination of any individuals. However, in such cases there is generally an overproduction of more or less random reactions to the new conditions, a gradual suppression of unfit or useless responses, and a persistence in making useful ones. Here is what seems at first sight to be a mechanistic explanation of fitness in the development and life-processes of the individual. But this is not strictly mechanistic, for the organism itself ceases to make useless or harmful responses, and persists in making useful ones; that is, it differentiates or distinguishes between the two. In the behavior of organisms this process of adjustment is known as "trial and error," and finally trial and success, but it is not entirely mechanistic, for in the elimination of certain responses and persistence in others there are always ends to be attained; trial and error is only a means to these ends.

In Darwin's theory, the environment is the eliminator of unfit individuals, and this process might be regarded as

purely mechanistic if one did not inquire why the environment and the organism are so related to each other that increasing efficiency of structure and function has resulted in the course of progressive evolution. A study of the relation of organisms to their environment shows that while the organism fits itself to its environment, the environment is remarkably fitted to the organism. The peculiar properties of water, carbon dioxide, and the carbon compounds in general, are uniquely suited to the origin and continuance of life as it exists on earth, and L. J. Henderson has said that there is not one chance in many millions that all of these peculiarly favorable conditions should have come about by mere chance. There is then a "fitness of the environment" for life as well as a fitness of life for the environment. From this larger aspect, organisms and environment are not independent but intimately related factors in evolution and development, and in both we see not only mechanism but also finalism. It is this appearance of teleology in all nature, this intimate connection and reciprocal interaction of means and ends, no less than the interrelationship of the objective and the subjective, that justifies the title of Bowman's book, *A Sacramental Universe*. Darwinism has discredited the supernatural origin of fitnesses, but not their reality; it controverts some of the arguments of Paley and the Bridgewater treatises, but not the underlying teleology of nature.

The recent death (April 18, 1941) of Hans Driesch, Professor Emeritus of Philosophy in the University of Leipzig, recalls his voluminous publications in support of a teleological principle in organisms. As a student he accepted the machine theory of life, but experiments on the eggs of sea-urchins and many other invertebrates convinced him that fragments of eggs could develop into whole animals. He maintained that the early cleavage cells were "like balls in

a pile," and that each one of them was "totipotent," that is, it could develop into a complete animal. Consequently he rejected the mechanistic conception of life. He said it was impossible to conceive of any machine that could be broken up in the three dimensions of space, and the fragments be capable of producing whole machines. Furthermore the ability of many organisms to restore lost parts, and of all organisms to heal wounds, led him to the conclusion that there is something in living things that is non-mechanistic and non-causal, which something, following Aristotle, he called "entelechy." In the adaptive behavior of organisms he postulated a similar principle which he called "psychoid," and in other writings "soul."

It is now well known that the instances on which he first based his conclusion that isolated cleavage cells or fragments of eggs are all alike and totipotent are not strictly true. The cytoplasm of eggs and cleavage cells is differentiated more or less in different species, and this differentiation increases throughout development, but in every cell there is a nucleus which remains undifferentiated, and, when the cytoplasm is not too highly or too irreversibly differentiated, it may be reorganized under the influence of the undifferentiated nucleus.

There is here, and in all development, regeneration, and behavior, a material, causal basis for all these regulative phenomena, and in this sense they conform to a "machine-theory" of life, only the machine is much more complicated than Driesch supposed, for the vital machine includes undifferentiated nuclear machines inside differentiated cytoplasmic machines.

There is the best of evidence that mechanisms, that is, matter, energy, causality, are present in all vital phenomena, but there is also good evidence that in the living world at

least, and perhaps also in the lifeless, this mechanism is so constituted and directed that it leads to certain ends. Mechanism is universal, but so also is finalism. In my conception, the relation of mechanism to finalism is not unlike that of structure to function—they are two aspects of organization. The mechanistic conception of life is in the main a structural aspect, the teleological view looks chiefly to ultimate function. These two aspects of life are not antagonistic, but complementary.

6. PSYCHIC DEVELOPMENT

While survival is the chief end of living things, it is not to be assumed that this is in most organisms a conscious aim. On the contrary, there is no evidence that lower organisms are aware of any such aim. But the fact that all show differential sensitivity and reactivity, that is, attractions and avoidances, or positive and negative tropisms, seems to indicate a capacity to differentiate between that which is satisfactory and that which is the reverse. Tolman has recently designated such phenomena as "satiations" and "sufferances."[1]

Satisfaction and dissatisfaction are subjective phenomena, and, as such, they are generally denied any place in objective science. But they are real phenomena, nonetheless, and must be taken into account in any attempt to explain the behavior of living things. Who can observe the behavior of an amoeba taking in certain food substances and rejecting others, following after and catching another amoeba, losing it and then catching it again, as Jennings has described, without concluding with him that if amoeba were as big as a dog we would think its behavior intelligent? Para-

[1]E. C. Tolman, "Motivation, Learning and Adjustment," *Proc. Amer. Philos. Soc.*, 84, pp. 543–563 (1941).

mecium avoids extremes of heat or cold, salts and irritating substances, and comes to rest in masses of bacteria on which it feeds.

Even plants behave "as if" they derived satisfaction, as they certainly derive benefits, from certain movements. Shoots of germinating seeds persist in growing up toward light and air, and roots in growing down toward soil and moisture, even if often inverted or the movement blocked. Trees send roots long distances toward water-drains, growing potatoes in cellars send shoots many feet toward windows and light. Hundreds and even thousands of movements of organisms or of their parts show such phenomena of differential sensitivity and selective reactivity, moving toward certain sources of stimuli and away from others "as if" they experience satisfaction or dissatisfaction. No one doubts that this is true in human behavior, and all the evidences indicate that higher animals experience pleasure and pain, and attempt to secure the former and avoid the latter. No one knows how far down in the scale of life such feelings and motives are found, but certainly there must be some precursor of such feelings perhaps even in amoeba and also in germ cells of higher forms.

Jedes Thierchen hat sein Pläsierchen.

Yes, I know that all these phenomena are called tropisms and are supposed to be explained by that word, but this is mere nominalism and no real explanation.

In this connection it is interesting to recall that strict mechanists, such as the late physiologist Jacques Loeb, reject altogether the theory of trial and error. They recognize that it contains a psychic element which they think is inconsistent with their mechanistic conception of life, in which all behavior is fixed and machine-like. They hold that the activities of all protoplasm from protozoa to man

are "forced movements," without any choice or freedom. The denial of selective responses and choice seems to such mechanists an absolutely necessary conclusion from their basic premises. I recall a conversation which I once had with Loeb on this subject. After he had vigorously denied the reality or possibility of human freedom, he saw his little son running down the steps with a large open clasp knife in his hand. At once he shouted, "Bobby, close that knife. You might fall on it." I said, "Now Loeb, practice your philosophy," and in reply he merely winked one eye at me.

The fact is that no philosophy that denies a certain degree of freedom to man can be lived, and there must be something wrong with any philosophy that cannot be lived. Starting with the assumption that there are no elements or germs of the psychic life in protozoa, germ cells, and lower organisms, it is possible to reach the conclusion that there are no such phenomena in man. But if we reverse this process, and, beginning with those phenomena in man, which we know better than any and all others, try to find how far down in the animal kingdom we can trace the origin of these, we are following a safer procedure. This is precisely what every embryologist does in tracing the origin of developed structures, he works backward as well as forward in development—to the earliest traces of certain structures and then forward from these "anlagen" to the developed organ. In short, we should not leave man and his fully formed characteristics out of account in the study of development and evolution. From our human point of view, man is the measure and the measurer of all things.

The fear of anthropomorphism or "anthropism" (Sherrington) has been carried too far in biology. We are told that we must not impute human experiences or faculties to subhuman organisms, and yet we are assured that man is

kin to the animals and has evolved from them. We are taught that the human being is a colony of cells, each more or less like an amoeba, and that human characteristics are the combined results of amoeboid characteristics, new combinations giving rise by creative synthesis to new qualities. In short, we may interpret man in the light of our knowledge of amoeba, but we must not impute to lower organisms even the germs of human qualities; we must avoid "anthropisms" but not "amoebisms." Of course the truth here, as in all development, lies between the extremes of absolute epigenesis and complete preformation. Developed human characteristics are not found in germ cells nor in lower animals, but their germs or elements are found in all living things. To deny this is not only a denial of the kinship of man with animals, but it is a refusal to think logically and humanly, for how can we think at all except anthropically? Even mechanisms are conceived in the light of human machines.

The germinal elements from which man's mental life develops are found in all living things. But these mental germs must develop if they are to produce mind. As the body is not actually present in the germ, so the mind is not present in a developed condition in the germ nor in the lower forms of life. Differential sensitivity and selective reactivity, satiations and sufferances or satisfactions and dissatisfactions, are the protoplasmic or germinal beginnings of psychic phenomena, for ability to distinguish (or differentiate) between stimuli, and to select (respond positively) or reject (respond negatively), is the basis of behavior, and even of wisdom, wherever found. For what is wisdom, even in man, but this fully developed ability to distinguish and select? There is a wisdom of the body, as Sherrington and Cannon have emphasized, a wisdom in

meeting needs and crises, often equal to, if not greater than, that of human intelligence; and similarly there is a wisdom of every living thing from the simplest protoplasmic masses to man himself, from the germ cell to the adult, namely, the fundamental wisdom of life.

The illuminating studies of Coghill have shown that the behavior of the newt, Amblystoma, "develops from a primarily integrated total pattern of action and the individuation of partial patterns within the total pattern. . . . The nervous system concerns itself first with the integrity of the individual and only later makes provision for local reflexes."[1] This is typical of the whole course of differentiation, both physical and psychical. The general function of differential sensitivity, found in one-celled animals and plants in which the protoplasm is sensitive to many kinds of stimuli, becomes differentiated and segregated in special portions of the protoplasm, and then in the special sense organs which are especially sensitive to touch or vibration (hearing) or chemicals (taste and smell) or light (vision); and the differential reactions of the general protoplasm develop into the special reactions of organs for motion, ingestion, digestion, secretion, respiration, reproduction, reception and conduction of stimuli.

In the same way, the psychic elements of differential sensitivity and reactivity in the germ differentiate into those of the adult—tropisms and reflexes into instincts and habits (conditioned reflexes); organic or protoplasmic memory into associative memory; adaptive responses through "trial and error" into intelligence or the ability to learn by experience and reason, or ability to make general comparisons (generalizations); varied responses due to conflicting stimuli or

[1]G. E. Coghill, "Early Development of Behavior in Amblystoma and in Man," *Arch. Neurology and Psychiatry,* vol. 21 (1929).

physiological states into inhibition, choice, and will. In this whole process general psychic functions become more highly specialized, localized, and efficient.

All protoplasm responds to stimuli in specific ways, which are known as tropisms and reflexes. They are mechanistic responses showing relatively little variability. Simple reflexes like the contractions of an isolated muscle are, under constant conditions of muscle and environment, fixed and machine-like, but when connected with other parts of the organism the conditions are less constant and the response is more variable. In some of the earliest body movements of the human embryo before birth many muscles and nerves cooperate in the movements of head and trunk and limbs in response to stimuli. If the nose or mouth of a three month human embryo is stimulated by touching it with a camel's-hair brush, the head moves from side to side and the hands come forward to ward off the brush. These movements are purely mechanistic, and their complicated patterns and successions are determined by the inherited organization of the embryo. After birth, the complexity and number of such responses greatly increases; simple reflexes are connected together in series, one reflex following another in some complicated act. For example, stimulation of the lips of the new-born infant causes numerous muscles to contract in a definite sequence, resulting in the act of sucking and swallowing. The numerous reflexes involved in this act are connected together like links in a chain. The whole response is machine-like and is inherited along with the muscles and nerves. When such a chain of inherited reflexes is long and involves many muscles and parts, it is often called an instinct. The acts of sucking and crying in the infant are instinctive. They are at first purely mechanistic, but gradually they tend to lose this machine-like

character and become more variable. The stimulus to the lips may not induce the sucking reaction, but an avoiding one; other conflicting stimuli, or the physiological state of the stomach, may be responsible for this change. The behavior of the embryo is more fixed and automatic than that of the baby, and throughout development there is an increase in the plasticity and variability of behavior which goes hand in hand with the increase in complexity of organization, interaction of parts, and number and variety of stimuli. But there is no evidence that action of any kind ever takes place in the absence of external or internal stimuli; so-called automatic acts are those resulting from internal stimuli.

Enormously long and complicated chains of reflexes occur in all animals in connection with the conservation of the individual and the perpetuation of the race. Nowhere is behavior more complicated than in relation to sex and reproduction. From the relatively simple reactions of spermatozoa and egg cells to the enormously complicated reactions of males and females by which the germ cells are brought together; from the behavior of individual cells to the psychology of parents in courtship, mating, nest building, feeding and protection of the young, we find in the animal kingdom some of the most remarkable of all chain reflexes. Many insects and lower animals perform these complicated acts but once in their lives; they have no chance to learn them by practice or imitation; they are as perfect and automatic as the form of the organism itself, and they must therefore be inherited. These are undoubted instincts, complicated chain reactions that are relatively fixed and automatic.

In higher animals and especially in man these chains of reflexes are less rigidly fixed than in insects and are more

capable of improvement by practice. New chains of reflexes may be set up by bringing about new connections of links and chains, or, more accurately speaking, new paths of conduction in the nervous system. Such are the "conditioned reflexes" of Pavlov and the "habits" that may be established by training and practice in higher animals and man. All such complicated acts as learning to walk and talk and play games are such conditioned reflexes or habits. They are not inherited instincts, only their potentialities in the organization of muscles and nerves are inherited, and the uses to which these organs are put are determined by practice, that is, by selection from among many possible reactions those which are most satisfactory, and elimination of the others, in short, a process of trial and error, and finally trial and success.

This ability to establish new habits and in general to learn from experience is one of the most characteristic properties of man. It is unquestionably associated with the greater "plasticity" of his organization, which probably means the greater number of nerve cells and fibers and association tracts in his nervous system, and consequently the greater number of paths that may be broken through this complicated system.

Another fundamental property of protoplasm in general is a basal form of memory. The effects of a previous stimulus are in some way stored in the protoplasm for a shorter or longer time, and are added to the effects of a subsequent stimulus. This is known as "summation of stimuli." In the insectivorous plant known as the Venus Fly-trap, a single stimulus of the sensitive hairs on the leaf causes no movement, but a second stimulus within a period of about three minutes springs the trap and causes it to close. Evidently the effect of the first stimulus is retained in the cells of the

mechanism for about three minutes, after which it passes away. Similarly the protoplasm of a muscle or nerve or gland cell retains for a time the effects of previous stimuli. This is protoplasmic or "organic memory" (Herring). Its effects are strikingly seen in the training of muscles and nerves of a child to perform accustomed acts, such as walking, talking, playing games.

Just as complicated instincts and habits develop out of simple tropisms and reflexes, so intelligence and reason develop out of adaptive or useful responses, which in turn are the results of trial and error, that is, the persistence of the fit. This persistence in the performance of useful acts and the avoidance of useless ones is in animals with nerve centers the result of associative memory. Any animal that can learn anything, such as the association of particular stimuli with particular results, e.g., a call or the ringing of a bell with the offer of food, has associative memory. Such memory is found only in animals with complicated nervous systems and association tracts between sensory and motor centers.

It would take us too far afield to undertake here a review of the intelligence, social organizations, communications, and cooperations of animals, but there is no doubt among those who are well acquainted with the subject that all of these characteristics are found among animals below man. And yet they are slightly developed as compared with man, and there is still less evidence of self-consciousness, introspection, and reasoning in animals, although, as Huxley once said, nothing short of becoming a crayfish would reveal what a crayfish feels and thinks.

By general agreement among students of animal psychology there are few signs of the ability to generalize or reason among even the higher mammals. There is no doubt

that they are often intelligent, that is, they can learn by experience to do useful or desirable things. A burnt cat as well as a burnt child dreads the fire, and a horse can learn to lift a latch and open a gate or door and in this one respect is intelligent, for intelligence is the ability to profit or learn by experience. But Thorndike found that cats that had learned by trial and error to open a door by turning a button were quite unable to turn this intelligence to a different kind of fastening, such as the lifting of a latch; they had to go through the slow process of learning by trial and error how to lift the latch. A child would have to go through the same process, but it would make fewer errors and learn faster because it would soon get the *idea* of resemblance in structure or function between a button and a latch, that is, it would begin to *generalize*.

It is this capacity of generalization, which is the basis of all reasoning, and which is so little developed in animals as compared with man. Comparisons of resemblances and differences are fundamental in all intelligence and reasoning. In the lowest stages of intelligence, resemblances must be very close, amounting almost to identity, to be recognized, the latch and door must be very similar to the ones already learned to permit the extension of previous experience to the new latch and door. With the growth of intelligence, comparisons between objects or events that are less and less alike become possible. Such resemblances or differences range all the way from practical identity through similarity to complete dissimilarity. Thus the faculty of generalization and reasoning is born, and thus the scientist and philosopher can compare the mental resemblances and differences between animals and man.

Inhibition, choice, and will undergo natural development in both phylogeny and ontogeny. In the words of Professor

C. O. Whitman, "Choice is not . . . a little deity encapsuled in the brain. . . . But increased plasticity invites greater interaction of stimuli and gives more even chances for conflicting stimuli." The will is the ability to use as internal stimuli the results of previous experience and "the freedom of the will" is directly proportional to this ability. Our freedom is measured by our intelligence and our ability and desire to use it as stimulus or inhibition.

In all animals behavior is modified through previous experience; where several responses to a stimulus are possible, and where experience has taught that one response is more satisfactory than another, action may be limited to this particular response not by external compulsion but by the internal stimulus of experience and intelligence. This is what we know as choice or will. Freedom of action does not mean action without stimuli, but rather the introduction of the results of experience and intelligence as stimuli. The activities which in the lower animals are "cabined, cribbed, confined" reach in man their fullest and freest expression; but the enormous difference between the relatively fixed behavior of a protozoon or a germ cell and the relatively free activity of a mature man is bridged not only in the process of evolution, but also in the course of individual development. . . .

The most complex of all psychic phenomena, indeed the one which includes many if not all of the others, is consciousness. Like every other psychic process this has undergone development in each of us; we not only came out of a state of unconsciousness, but through several years we were gradually acquiring consciousness by a process of development. Whether consciousness is the sum of all the psychic faculties, or is a new product dependent upon the interaction of the other faculties, it must pass through many states in the course of its development, stages which would commonly be counted as unconscious or subconscious states, and complete consciousness must depend upon the complete development and activity of these other faculties, particularly associative memory and intelligence. . . .

Finally, there seems good reason for believing that the continuity of consciousness, i.e., the continuing sense of identity, is associated with the continuity of organization, for in spite of frequent changes of the materials of which we are composed our sense of identity remains undisturbed. However, the continuity of protoplasmic and cellular organization generally remains undisturbed throughout life, and the continuity of consciousness is associated with this continuity of organization, especially in certain parts of the brain. It is an interesting fact that in man, and in several other animals which may be assumed to have a sense of identity, the nerve cells, especially those of the brain, cease dividing at an early age, and these identical cells persist throughout the remainder of life. If nerve cells

continued to divide throughout life, as epithelial cells do, there would be no such persistence of identical cells, and one is free to speculate that in such cases there would be no persistence of the sense of identity.

Organization includes both structure and function, and continuity of organization implies not only persistence of protoplasmic and cellular structure but also persistence of the functions of sensitivity, reflexes, memory, instincts, intelligence and will; the continuity of consciousness is associated with the continuity of these activities as well as with the structures of the body in general and of the brain in particular. It is well known that things which interrupt or destroy these functions or structures interrupt or destroy consciousness. Lack of oxygen, anaesthetics, normal sleep cause in some way a temporary interruption of these functions and consequently a temporary loss of consciousness; while certain injuries or diseases of the brain which bring about the destruction of certain centers or association tracts may cause permanent loss of consciousness.[1]

7. SOCIAL AND MORAL DEVELOPMENT

All development is the result of the interaction of heredity and environment, and the germ changes into the adult only in response to environmental stimuli. The effects of these stimuli and responses are registered in the organism, and persist there for a longer or shorter time. In the analysis of the processes of development of the body as well as of the mind the "creative synthesis" brought about by the interaction of organism and stimulus has been too much neglected. Biologists generally regard the organism as all-important, the stimulus as relatively unimportant. For example, many kinds of stimuli may cause a muscle to contract, and this has led to the prevalent view that the stimulus merely sets off a reaction already prepared for in the organism, that the stimulus is like the spark in the gunpowder and nothing more. But the living machine is not altogether that kind of a machine, for the stimulus not only sets off the explosion, but its effects persist for a longer or shorter time in the surviving mechanism. A muscle or nerve that has been stimulated is not the same as it was before, as is shown

[1]E. G. Conklin, *Heredity and Environment* (1923), pp. 52–54.

by all phenomena of after-effects, training, and organic memory. In short, the effects of stimuli, even in the simplest physiological responses, enter into and modify the responding organism.

This is more evident in the responses of entire animals and plants than in their individual parts. Even in protozoa responses are modified after repeated stimuli, and usually in beneficial ways.[1] "Summation of stimuli" in plants and animals means that some more or less lasting change is caused in the protoplasm by the stimuli. All protoplasmic or organic memory, such as is found in the training of muscles and nerves in learning to walk or talk or play games, means that the protoplasm is changed in reacting to stimuli. All learning, all profiting from experience, means that the organism is modified in specific ways by its responses to particular stimuli.

Human development is especially influenced by environment. In addition to the physical and chemical environments, which all organisms share, man is subjected to potent intellectual and social environments. Intellectual, emotional and social stimuli and responses leave more or less lasting effects on the person. In this sense all of us can say with Ulysses "I am a part of all that I have met," and conversely, "All that I have met has become a part of me." It is in this sense that we are "heirs of all the ages," for our social environment has entered into our development and has become a part of our very selves.

The unknown individual or tribe that first learned the uses of fire and how to conserve or produce it, the person who first made a stone hammer or spear, or first learned the uses of a lever or wedge or wheel, the tribe that first learned the uses of metals or how to harden copper or smelt iron from the ore—all these contributed to the physical, psychical,

[1]H. S. Jennings, *The Behavior of the Lower Organisms.*

and social environment in which we live, and this environment has entered into the making of our personalities. In like manner, the development of articulate speech, the devising of graven or written characters as symbols for ideas and words, the invention of a phonetic alphabet, as well as of paper, printing, the telegraph, the telephone, the radio, and a thousand other discoveries and appliances—all these have created an intellectual and social environment which has not only influenced our development but has also become a part of our very selves.

Similarly, the thoughts, emotions, and ideals of our fathers and mothers and friends and teachers—more than all perhaps their very characters—have become a part of us. Concepts of right and wrong, of honor and loyalty, of devotion and patriotism, of altruism and religion, were not born with us but have entered into us through our social environment. Also selfishness and cruelty, fear and hate, aggression and pride, are not primary and inherited reflexes or instincts, but are largely conditioned reflexes—often inculcated and perpetuated by associates, teachers, and leaders. Our social and ethical environment is more potent in shaping our ideals of cooperation and conflict, of right and wrong, than inheritance through the germ cells.

Heredity, or the germ-plasm, determines only the capacities and potentialities of an organism. In every individual there are many capacities that remain undeveloped because of the lack of suitable stimuli to call them forth. These inherited potentialities are both good and bad, social and anti-social, and it is the purpose of good education to develop the former and suppress the latter. To trust wholly to germ-plasm is to forget that heredity furnishes capacities for evil as well as for good, and to disregard the universal experience of mankind.

Personality is the product not only of heredity but also of

environment. We are the children not only of our parents and more distant ancestors from whom we have received our chromosomes, but also we are the intellectual, social, and spiritual children of all those persons whose ideas, ideals, and examples have entered into the making of our characters. The development of our mental and moral characters is the product of heredity and environment, much of it far removed from our personal control. But with the birth and growth of intelligence, inhibition, and will, some of the environmental influences and internal motivations come under our control and thus we become "free moral agents."

But do the soul and spirit of man undergo natural development as the mind and body do? With most persons there is need of clearer definitions of what is meant by these words. For the prevalent view is that soul and spirit are breathed into the body by supernatural creation. But scientists generally maintain that these also are products of natural development. Some extremists hold that they are mere words having no factual existence; all admit the reality of body and mind and some maintain that these constitute the whole man. But this would involve assigning to body and mind the emotions, aspirations, and ideals of men, together with their social, ethical, and religious impulses and responses. One definition of soul is, "A substantial entity believed to be that in each person which lives, feels, thinks and wills," i.e., the "anima" or life. A second definition is, "The moral and emotional part of man's nature; the seat of sentiments and feelings in distinction from intellect."[1] From the scientific point of view the second definition is preferable to the first, but biological science does not admit that body and mind and soul are distinct and separable

[1]Century Dictionary.

entities. They are different aspects of one organism, as structure and function are, and they are not separate or separable. Likewise the word "spirit," has many different meanings, ranging all the way from breath, vapor, essences and alcohol, to ghosts or "gaseous vertebrates" and to supernatural beings. But as applied to man, its meaning, in scientific usage, is character, temperament, essential nature.

In the days before there had been much study of comparative and genetic psychology there were scientists, like Alfred Russell Wallace, who were strong defenders of the natural evolution of man's body, but believed that mind and soul came by supernatural creation. Today there are few if any anthropologists, psychologists, or sociologists who take this view. The evidences in favor of mental and emotional, social and ethical, evolution and development are as cogent as those in favor of physical evolution and development. However, there are still many half-way evolutionists among non-scientists who admit evolution of the body, but deny it to the mind and soul.

Before there was any knowledge of the early stages of human embryology it was generally held that "about forty days after conception life enters the embryo from the outermost sphere of the Ptolemaic Universe" (Sherrington), and that soul as well as life was first imported into the embryo when it began to move or was "quickened." Many religious beliefs and legal prohibitions are founded upon this antiquated doctrine. The transmigration of souls from dying men or animals to the new human being has been taught in the philosophy and religion of many lands. All such beliefs are completely discredited by modern science.

The initial origin of the Hominidae was probably a million or more years ago, and there is necessarily much speculation as to the precise manner and means of that

origin, but the origin of individual human beings here and now is a present and everyday process. There is every evidence that the body, mind, and soul develop by natural processes from the human germ. Those who assume a supernatural origin of the mental and moral qualities of an infant or child might reasonably be expected to indicate when and where in the course of development this supernatural creation or intervention occurs. There is no evidence at any point in development of the supernatural introduction of life, mind, or soul nor of any supernatural interference with natural processes.

This is no more old-fashioned "materialism" than it is "psychism," for it endows all protoplasm with the elements or germs of the psyche, perhaps all matter and energy with "the promise and potency of life." In some respects it is akin to the monadology of Leibniz or the pan-psychism of Thomas Carlyle, Fechner, and Paulsen. On my part it is an honest attempt to account for the development of the entire personality in accordance with scientific evidence. Physiologists and bio-chemists frequently assert that life and all its properties, including human consciousness, purpose, and ideals, are purely and solely physico-chemical problems (*vide* Loeb, Hogben, Sherrington, *et al.*); or they attempt to show that these psychical experiences are not real (e.g., J. B. Watson, *et al.*) But to deny the reality of subjective phenomena is equivalent to denying the reality of all phenomena, even the objective, for the latter can be apprehended only by means of the former. If the germs of life, mind, and soul are found in physico-chemical processes, we have merely endowed molecules, atoms, and electrons with these potentialities. It should be the aim of proponents of the "mechanistic conception of life" to show that psychic and subjective phenomena in general are germinal or potential in matter and energy, for subjective phenomena are

realities, even though some of their contents, such as fantasies, are not, and it is only through subjective experiences that we become aware of the objective world.

This is neither the time nor place to deal in detail with many aspects of genetic psychology and sociology, but for present purposes it is sufficient to indicate that the entire human being—body, mind, and soul—develops by a process of progressive differentiation from the structures and functions of the germ cells in response to physical, mental, and social stimuli. Those who deny such development do not and cannot rest their case upon scientific evidence. So far as I can see, the only rational and scientifically defensible method of maintaining divine control over the evolution of man and the development of individuals is to assume that back of all development and evolution, back of all biology and chemistry and physics—indeed throughout all nature—is divine immanence.

On a July day in 1868, John Tyndall, the English physicist, who was also a great mountain climber, sat on a crag of the Matterhorn, and thinking of the molten state from which it came, and of the star dust from which the molten world originated, asked himself whether that primordial fog contained potentially the feelings with which he regarded the Matterhorn.[1] We may answer that in accordance with universal evolution those feelings were born not only from primordial matter, but also from all the energies and conditions that had acted on that matter through countless ages. New combinations of elements had given rise to new chemical compounds with entirely new properties in accordance with the universal principle of creative synthesis, emergence, or creative evolution. Environment had entered into the formation of that granite and into all the processes that had led to the origin of life. And in the bil-

[1] "Musings on the Matterhorn, 27th July, 1868."

lion years of organic evolution, environment had entered into the countless creative syntheses which culminated in man. And in the development of Tyndall, physical, intellectual, social, and spiritual environment had entered into the formation of his mind and emotions, so that he was the product of all that had gone before.

This does not imply that the characteristics of human personality are found in all nature, but it does indicate that the *potentialities* of all that has come out of the evolution of matter, of worlds, and of man were in the original constitution of the universe and its later transformations. How those potentialities got there no one knows, why the environment was such as to bring about those transformations is unknown; the theist attributes them to God, the atheist to Chance, the scientist to Nature, and the realist may attempt to synthesize all of these concepts. The germinal potentialities of all development must be in at the beginning or must be added later. In the development of every living thing, two distinct factors are necessary, the original constitution of the germ and the particular environments that act upon it. The egg contains the germs of functions as well as of structures of the psyche as well as of the body.

Those who seek for the causes of the mental and spiritual qualities of mature persons will not find them in the matter of the germ cells alone, but also, and chiefly, in mental, social, and spiritual environment. Such environment is acting on every child during its development, and thus mental and moral qualities develop through contact with persons possessing those qualities; and in later years through the precepts and examples, the ideals and inspirations of all whose words and deeds have become a part of our social and spiritual heritage. In this way nature (or God) works through human agencies in the development of intellectual, social, and spiritual qualities in man.

III

THE REAL AND THE IDEAL

1. SCIENCE VERSUS TRADITION

SINCE the earliest records of human history, the antinomy of the real and the ideal, of the material and the spiritual, have appeared in the thoughts, literatures, and religions of all peoples. This antithesis has been especially emphasized during the past three or four hundred years by the revelations of modern science.

(1) *The Copernican Theory Versus a Flat and Stationary Earth.* The year 1940 marked the four hundredth anniversary of the publication of a preliminary account of the Copernican theory, the definitive publication of which did not occur until 1543 when Copernicus was on his death bed. This theory and its confirmation by Galileo was in many respects the most revolutionary discovery in the whole history of science, but like many other great discoveries it was in many respects anticipated in ancient Greece and then forgotten. As long as it was possible to regard the earth as the center of the universe, and the sun, moon, and stars as designed to give light on the earth, it could be said that in all creation there was no place so important as the earth, on the earth nothing superior to man, and in man nothing supreme but mind and soul.

The Copernican theory was the first step of modern science in the demoting of man from this supreme position, and it seemed to contradict the evidences of common sense as

well as the plain statements of the Scriptures. Consequently it was denounced by the Roman Catholic Church as heretical and directly opposed to the authority of the Scriptures; Martin Luther called it a "fool idea," and John Wesley admitted that "it tended to infidelity." Even Francis Bacon, the herald of modern science, could never believe that the earth revolved around the sun. The old conception of a flat earth in the center of the universe dies hard, and there are still some benighted religious sects that make this a cardinal doctrine of their faith. But among enlightened people everywhere there is no longer any question of the truth of the Copernican theory.

(2) *The Law of Gravity Versus Supernaturalism.* One hundred and forty-five years after the death of Copernicus the Royal Society of London finished the publication of Newton's *Principia Mathematica* in which the law of gravity was demonstrated, perhaps the most fundamental law in all nature. I once heard that eminent mathematician and astronomer, Ernest W. Brown, say that his calculations of the mutual attractions and motions of the earth and the moon showed that the law of gravity, namely, that bodies attract one another directly as their masses and inversely as the square of the distance between them, was true within a possible error of one part in ten millions, and he expressed his amazement that it was possible by a few words and symbols to express any conception with so great accuracy. William Jennings Bryan used to say that he could demonstrate the law of gravity by throwing his hat into the air, but it took Newton twenty years to demonstrate this law.

When the wide applications of this principle to the movements of all the heavenly bodies as well as to all objects on earth were first fully appreciated, some persons denounced the law of gravity as an attempt to banish God from his

universe and to put a mere mechanical law in his place. Even today some critics of science and advocates of supernaturalism take great joy in the minor corrections of Newton's law proposed by Einstein, but no rational person now denies that there is a universal law of gravity and that, as Samuel Rogers wrote,

> The very law which moulds a tear
> And bids it trickle from its source,—
> That law preserves the earth a sphere,
> And guides the planets in their course.

(3) *Natural Evolution Versus Supernatural Creation.* In 1859, one hundred and seventy two years after Newton's announcement of the law of gravity, Charles Darwin published his book on *The Origin of Species,* giving convincing evidences of the evolution of species and larger groups and proposing a theory of the principal causes of evolution. In 1871, his book on *The Descent of Man* furnished evidences of the evolution not only of the human body but also of the mind and morals of man. Probably no scientific generalization has ever met with more violent opposition than this, but year by year it has received increasing confirmation, so that now it is almost universally accepted by scientists, and is opposed only by those who reject the methods and results of science.

These three dates, 1543, 1688, 1859, mark three of the major revolutions in human thought regarding man's place in nature. Thus step by step science has demoted man from his former proud eminence as "lord of creation," and has replaced the concept of supernatural fiat by that of natural law. The earth is a minor planet in a second-rate stellar system in one of millions of island universes. Man is one of a million known species of animals that have appeared, flourished, and disappeared during a thousand million years

past. The human species, like all other species, has come into being by natural evolution and not by supernatural creation. In both phylogeny and ontogeny, body, mind, and morals have developed by natural processes. Even ideas and ideals of God, religion, ethics, and immortality have undergone natural development in the course of human history and in the individual human consciousness. One after another, man's beliefs in his uniquely divine origin and immortal destiny, and his conception of an original paradise in which men were like gods and gods like men, have been cruelly shaken. Those who refuse to accept such conclusions and denounce the "naturalistic conception of man" show a lack of appreciation of the many sciences that deal with man. He can no more be placed outside of nature or superior to it than the earth can be located at the center of the universe.

(4) *Scientific Evidence Versus Emotional Beliefs.* Science is knowledge—organized, classified, verified knowledge of phenomena. It deals largely with objective reality, and in the search for truth it attempts to restrict subjective feelings, desires, and imaginations to the rôle of stimuli, but never to allow such feelings or desires to determine what is true and what is false. Many centuries of human experience have shown that knowledge based on accurate and tried observations and experiments is a safer guide to truth than unverified fancy, that reason is a safer judge than emotion, experiment a surer test than intuition. All advances that have been made in the sciences of astronomy, geology, physics, chemistry, biology, and psychology have been made by adherence to the methods of science, and not by means of wishful thinking.

And yet the scientist does not and cannot rule out all feelings and emotions in his quest for truth, because, for one thing, emotion and imagination as well as intelligence and

reason are elements of his nature that cannot be sharply separated or isolated, and, for another thing, they furnish the stimuli for this quest. But he can and must try all things by the tests of objective reality. Never does he test reality by ideality, reason by emotion, or fact by fancy, but always he reverses this process and tests fancy by fact, emotion by reason, intuition by experience.

Critics of science and the scientific method never fail to point out the fact that scientific theories and conclusions are constantly changing. If you would keep up with science, they say, you must consult the latest journals and books; whereas the superiority of art, literature, and poetry is shown by the fact that they are ageless, the oldest works often being the best. This argument asserts that beauty is not only more constant and perfect than knowledge, but also that emotion and intuition are safer guides to truth than the methods of science.

No one wishes to deny the fact that "knowledge grows from more to more." We are proud of the "advancement of science." We realize that knowledge is never perfect and that the progress of science consists in continual approximations to the truth without ever reaching absolute truth. Why it should be thought that primitive or static forms of art, literature, or poetry are necessarily superior to later and more progressive forms, is difficult to understand. Even artists and poets admit that the art and literature of ancient Greece were variations and, in some respects, improvements upon the art forms of earlier times, and if no possible improvements are conceivable over ancient Greek art, at least there have been many variations in the art forms of different times and places. In short, art and its appreciation vary as much as science.

But the correlative claim that emotion and intuition are

safer guides to truth than science is contradicted by many historic instances. Intuition taught that the forces and phenomena of nature were the acts of gods or demons or preternatural beings. All nature was regarded as the immediate expression of the wills of such beings. The lightning was hurled from the hand of Jove, the sea was disturbed or calmed as Neptune determined, Aeolus let loose or confined the winds, the earth trembled and volcanoes smoked when Enceladus turned over, Apollo drove the chariot of the sun across the sky, the earth was flat and the center of the universe, the planets travelled their appointed courses as they were guided by their angels, gods of birth and death and fate presided over human destinies, diseases of body and mind were caused by demons that took possession of human beings and could be driven out only by fire and water and magic. All nature was the expression of wills, big or little, good or bad, and the good must be praised, the bad circumvented by sacrifices or magic.

Most of these primitive intuitions concerning natural phenomena are now regarded merely as poetic symbolism, but they were not so regarded in former times. If the gods and demons have departed, it is because science has revealed the natural causes of these phenomena. Some of these primitive intuitions have only recently been cast aside by enlightened persons, but are still believed in by the ignorant. Among these is the belief in witches, who were supposed to be in league with the devil. By intuition all forms of superstition, magic, and folklore have been accepted as explanations of natural phenomena, and are still accepted by some persons. Astrology, palmistry, crystal gazing are held to reveal future events, and many thousands of deluded people pour out many millions of dollars every year in consulting the practitioners of these false sciences and black arts.

Weather prophecies founded upon the abundance of fat or fur or feathers of animals, the flight of birds, or the awakening of ground hogs, are accepted by multitudes as superior to those of the Weather Bureau, because they are founded on intuition rather than reason. By intuition some nations and races and persons know themselves to be superior to all others. They think with their blood and feel victory in their bones, and are certain that such intuitions are superior to cold science and reason.

What are these magical intuitions? Are they supernatural revelations of truth, superior to ordinary methods of common sense? They are notoriously liable to error, as has been demonstrated again and again in actual experience. In so far as intuitions are reliable and not mere fancies, and many such there are, they appear to be the results of keen observation and rapid, though often unrecognized reasoning. Does not reason as well as emotion enter into all valuable intuitions, whether in science, art, or literature? It is easy to point out examples of incorrect observations, fallacious reasoning, and false conclusions in the history of science, but are intuitions more free from error? Which is the safer guide in affairs of everyday life—in business, farming, industry, medicine—science or intuition? The value of intuitions is not in their superiority to reason but in their service as hypotheses to be tested by accurate observation, experiment, and rational deduction.

Macneile Dixon says, "The failure of science is to minister to the needs of the soul; the failure of religion is to meet the needs of the intellect"—which means that they have different aims and are not therefore in necessary antagonism. Both science and religion are necessary to minister to the needs of men, and therefore neither should attempt to impugn the aims of the other. Where conflicts arise be-

tween the two, they are due principally to attempts to extend the methods of one of these disciplines to the other. The satisfactions of the intellect and the satisfactions of the emotions are reached by different routes. The route of science is through verified and exact observations and strictly logical deductions as free as possible from emotions, but such methods would not lead to the production of great art, literature, or religion. On the other hand, the exaltation of the emotions and the subordination or elimination of exact methods of observation and deduction would not produce great science. "Logic does not help us to appreciate art, nor mathematics love" (Dixon). Poetry is not the mentor of astronomy nor religion of chemistry. I once heard Clarence Edmund Steadman compare the scientific description of an equinoctial storm with the poetic account of the same phenomenon. The Weather Bureau's report read: "An area of low barometric pressure over the north Atlantic states and high pressure over regions to the south was followed by strong southeast gales with high seas," etc. Longfellow reported the same phenomenon in these words:

> When descends on the Atlantic
> The gigantic
> Storm-wind of the equinox,
> Landward in his wrath he scourges
> The toiling surges,
> Laden with seaweed from the rocks.

Winds and waves are personified and their action pictured in pleasing language. Both reports deal with the same phenomenon but with different aims. Science attempts to record events and their causes as established by careful observations and rational deductions; poetry and art appeal to the emotions through pleasing forms, symbols, rhythms, and imaginations.

Through many centuries objective science has met the

opposition of subjective emotions, and new knowledge the antagonism of old traditions, popular beliefs, and mystical intuitions, but never has inner consciousness or emotional conviction or intuition overthrown objective reality, never have pleasant fancies destroyed stubborn facts. In spite of ancient cosmogony and theology, the earth is not flat nor the center of the universe; in spite of Galileo's inquisitors, the world does move; in spite of the creation story of Genesis, the world was not made in six days; in spite of the impassioned convictions of some preachers and rural legislators, evolution is a fact; in spite of the intuitions of astrologers and spiritists and mystics, objective science and scientific methods stand fast.

2. OBJECTIVE AND SUBJECTIVE PHENOMENA

Of course subjective phenomena are real in that they exist, albeit in inner consciousness, and as real phenomena, there are scientific ways of dealing with them. The objective causes and results of feelings, emotions, and desires may be explored by observation and experiment, and the ability of human beings to compare their subjective experiences opens a way to their scientific study. If we had no means of expressing our feelings, thoughts, and aspirations, and no way of comparing our own feelings with those of others, there would be no way of dealing scientifically with subjective phenomena.

(1) *Realistic and Idealistic Philosophies.* As a scientist I am what I suppose philosophers would call a "naïve realist," that is, I regard the external world as real and I think that objects are what they seem to be unless by scientific methods it can be shown that they are otherwise. At the same time, I realize that "what they seem" means what they seem to me and to others like myself who become aware of

the external world through our various senses and mental processes; and if one should choose to carry this admission "to its logical conclusion," and to disregard or discredit objective evidence, which I do not choose to do, it might lead to an idealistic philosophy that denies the reality of an external world or the possibility of arriving at a knowledge of it through sensory experience, and hence to a repudiation of science and its methods. Such a philosophy cannot be lived; it cannot be put to the test of experience because it repudiates the data of experience as a guide to reality. It is of interest to a scientist chiefly as an example of one of the many systems of philosophy which may be built up by logical processes upon premises that are unreal as judged by common experience. The philosophy of idealism is one of the many systems which seek to harmonize the objective and subjective aspects of human experience.

A realistic criticism of pure idealism has been expressed in the well-known limerick:

> There was a young man who said, God
> Must think it exceedingly odd
> That the sycamore tree
> Just ceases to be
> When there's no one about in the Quad.

To which a theistic idealist is supposed to have replied:

> Young man, your astonishment's odd,
> I am always about in the Quad,
> And that's why the tree
> Continues to be
> As observed by, Yours faithfully, God.

Thus a possible basis for pure idealism may be found in the all-inclusive ideal of an omnipresent God in whom all things exist and who is the only reality. But such a philosophy virtually denies objective reality and therewith all science.

I shall try to avoid the "holy jungle of transcendental metaphysics" (Swinburne), and shall seek a way through

the maze of philosophy by following the Ariadne thread of scientific realism, that is, by trusting the testimony of our senses and experiences unless and until they are proved to be untrustworthy.

But in the very fact of observing, comparing, and reflecting I am consciously or unconsciously recognizing the gulf between my subjective self and the objective world. This contrast between subject and object, the ego and the world, is fundamental in all conscious experience, and no entirely satisfactory bridge over this gulf has ever yet been constructed, although many attempts have been made by ancient and modern philosophers. Plato and Descartes concluded that it was unbridgeable, and that there is a fundamental duality in nature, but many modern philosophers and almost all modern scientists maintain the essential unity of the whole of nature. In common with these scientists and philosophers, such as Alexander, Dewey, Whitehead, William Temple, Archbishop of York, I am convinced that the reasoning, self-conscious personality has developed out of the unconscious biological organism or germ under the influence of environmental stimuli, and that body and mind are aspects of one and the same nature.

(2) *The Unity of All Nature.* The whole trend of modern science is toward a unitary conception of all nature—a real universe instead of a duoverse. Physicists once thought of matter and energy as distinct entities; it has now been demonstrated that matter can be converted into energy, and probably also energy into matter; both are real and distinct, but interconvertible. In chemistry the ninety-two elements were formerly supposed to be absolutely distinct; now they are known to be genetically related. Life was formerly regarded as separated from the non-living by an unbridgeable gulf; but now viruses, bacteriophage, and filter-

passers appear to be closing this gap. Fundamental dualism of the living and the not-living is still maintained by vitalists, but is doubted by most biologists.

Body and mind were until recently regarded as belonging to different universes. Recall the old quip, "What is matter? Never mind. What is mind? No matter." But genetic, experimental, and pathological psychology demonstrate the intimate union of body and mind, and lead to the conclusion that their interrelations are those of structure and function. It is highly significant that in most universities at present psychology is no longer classed with philosophy, but with the natural sciences.

The chief thesis in Professor Bowman's book, *A Sacramental Universe,* is that all nature, living and not living, conscious and unconscious, consists of "a prior union of physical and subjective systems . . . which reveals itself either as embodied spirit or as living body." This seems to be a form of monism or animism, which endows all nature with the promise and potency of life and mind and spirit. So far as I can see, it is scientifically unassailable.[1]

All such philosophies—dualism, idealism, monism—are primarily attempts to harmonize and rationalize the objective and subjective aspects of human nature, and only secondarily are extended to the universe at large. Professor Broad of Cambridge University has listed some seventeen hypotheses which have been advanced to explain the relations of mind and body, the ego and the world. You will not expect me, a "peeping scientist," to evaluate these, nor to present a new hypothesis to explain this mystery upon which philosophers from the Greeks to the moderns have expended their utmost mental efforts. Instead I have at-

[1]Elsewhere Bowman rejects monism and adheres to duality of the physical and the spiritual (see pp. 9 and 10 of his book).

tempted to indicate how a biologist looks upon this age-old problem through the lenses of development; for it is plain to the biologist that both body and mind have developed together as structure and function, not merely in ontogeny, but also in the course of phylogeny.

3. CONFLICTS BETWEEN EMOTION AND REASON

Reason, philosophy, and science are relatively recent developments in the human race; they go back a few thousand years at most, while the human family, the Hominidae, is at least a million years old. During this million years there has been a wonderful development of the cerebrum and of mental functions; but, as just remarked, the growth of objective science and that of strictly logical and rational habits of thought are limited to a few thousand years, while the methods of modern science, based upon carefully verified observations and adequately controlled experiments, are only a few hundred years old, and are known and practiced by only a few individuals out of the great mass of mankind. The ability to generalize and to draw logical conclusions, which processes are fundamental to philosophy, are among the latest developments in phylogeny and ontogeny, and the advent of science and scientific methods is the very latest step in this process. It is no wonder that these have reached and influenced so small a number of human beings.

This is sometimes called an age of reason and of science, but in reality it is anything but that. The majority of mankind have barely begun to be rational about things that most seriously concern them, and, as to the use of the scientific methods of exact observation and experiment with adequate controls, they know practically nothing. The affairs of men are directed and determined by emotions rather than by reason or science, and the biological explanation of this is

that they are more fundamental. Differential sensitivity and reactivity are found in all animals and plants and are fundamental characteristics of all protoplasm, but intelligence is limited to animals that can learn by experience; and reason, or the ability to make general comparisons, is probably found only in man. Feelings and emotions are immensely older than reason, and they are accordingly much more potent in shaping behavior. Those who exalt emotion over reason are all unconsciously exalting the animal way of life rather than the distinctively human way. Dogs, cats, horses, and higher animals in general manifest the same kinds of emotions that human beings experience. Fear, suffering, conflict, fight, joy, affection, fidelity, even responsibility, are manifested in greater or less degree by some animals. Considering such behavior, one can understand the saying of George Eliot, "The more I see of dogs the less I think of men." But of course these emotions of animals, while similar in kind, differ in degree from corresponding emotions of man.

A neighbor of mine, a professor of philosophy, who had never actually studied the real behavior of animals, held the usual opinion of the total difference in psychical characteristics between animals and men. But, after a little fox terrier had been adopted into his family, he used to tell me with astonishment and admiration of the human-like behavior, intelligence, and emotions of his dog. It was a constant source of wonder to the philosopher, and in the end I think he would have been inclined to attribute a genuine thinking and feeling soul to his dog. We have generally underestimated the many psychical qualities of higher animals. When a sophisticated biological student once asked my old professor, W. K. Brooks, why he treated his dog as if he were human, the professor replied, "If he has feelings

similar to my own, it would be cruel to treat him otherwise; if he does not have such feelings, it will do no harm to treat him as if he had."

The popular opinion that biologists generally are cruel, bloody vivisectors of "man's best friend" is a mistake. There are many heartless egoists of the old school of philosophy which regards man as the only creature with a mind and soul, who cruelly cause animals to suffer; but where there is one biologist of this kind there are multitudes of common people who constantly beat, injure, and kill innocent animals. When a friend of mine once protested against the cruel beating of a donkey by a driver in Italy, he replied, "But he's no Christian!" The Dean of the Episcopal Cathedral of Denver, who was a great fisherman, is said to have maintained that the hooked trout leaps and plunges for joy; probably the joy of the fisherman rather than that of the fish. Think of the senseless, useless, horrible suffering that men and women are constantly inflicting on animals—shooting and killing in mere blood lust, wounding and leaving to die in what must be great pain, leaving for days in steel traps until the poor creatures gnaw off their trapped legs or die in agony—and then say whether the animal experiments of physiologists, carefully planned for making discoveries that will relieve human suffering, and carried out, as surgical operations on man are—say whether they deserve the violent condemnation of those very persons who are so callous with regard to the sufferings which they inflict without any comparable purpose. The biologist, more than any other one, is in a position to know and appreciate the pleasures and pains, the joys and sorrows, of his humble fellow creatures, and it is one of the strong claims of biology for a place in all systems of education that it, more than any other science, teaches sympathy with everything that lives.

Of course there is a difference between such sympathy and mawkish sentimentality. Man's dominion over the fowls of the air and the beasts of the field gives him power and right to use them for his own welfare; for there is no altruism in nature that extends beyond the limits of a species to its own disadvantage, or that can supplant regard for one's own species. But man's larger knowledge and wider sympathies should guarantee humane treatment of all his fellow creatures.

The emotions of men are not only older and more potent, but they are much more uniform, than their reasonings. Indeed the latter are proverbially different; "Many men, many minds"; "When doctors differ who shall decide?" Such differences are usually the results of various emotions, opinions, beliefs, and not of real knowledge based on scientific evidence. In most concerns of life, scientific certainty is not possible; we conduct our lives on the level of probabilities of a high or low order, and what seems highly probable to one person may seem doubtful or improbable to another. Consequently, opinions and beliefs differ widely among men. But emotions are much more uniform, and when it is desired to bring about uniformity of opinion and action, appeal is generally made to the emotions rather than to verifiable evidence, as is seen in propaganda for or against war. We could not, even if we would, eliminate emotions in the conduct of our lives, but they should not be allowed to supplant or control intelligence and reason.

Reason is fallible in proportion to its admixture with emotion and its lack of factual basis. Because of this, Havelock Ellis has said that the most reasonable thing is to avoid too much confidence in reason. But a much more needed warning is to avoid too much confidence in emotion. Consider the man-made woes of the world—class conflicts,

national and racial antagonisms, wars—and say whether they do not arise from fear, pride, hate, aggression, rather than from factual and rational thinking. Consider the mental disorders that fill our asylums and overflow throughout the general population—emotional instability, hysteria, delusions, religious mania, insanity; all of them represent exaggerated development of emotions and subjective phenomena in general, and a lack of rational and objective control. Mankind in general seems to be possessed by every possible delusion, superstition, absurd belief, which are wholly without factual or rational basis. As Dixon says, "There seems to be a maggot in every human brain," the maggot of irrationality.

When the late William Morton Wheeler and I, in 1914, saw something of the magical ceremonies and wild corroborees of Australian aborigines, the ghastly wounds and punishments which they inflict on themselves, and learned of their crazy ideas regarding birth, life and death, ghosts, demons and magic, Wheeler said that this most primitive human race demonstrated that mankind was originally insane. I think rather that these aborigines, together with multitudes of persons of other races, demonstrate that the human species has come out of a non-rational and emotional mental condition, and is slowly emerging into a life of reason, but the animal inheritance is still strong in all of us.

Emotions are highly contagious. A dog fight sets all the dogs in the neighborhood into a fighting mood. A colony of chimpanzees goes into a frenzy of fury when any member of the colony is punished or makes an outcry. They howl, yell, and rage around in wild emotion, which looks and sounds for all the world like the ravings sometimes heard in a lunatic asylum. The two are indeed essentially similar, for they represent emotion uncontrolled by reason.

There are many evidences that the cerebrum is the principal seat of rational processes, while the lower centers of the brain are chiefly concerned with the vegetative, instinctive, and emotional processes. Bard has found that cats from which the cerebrum has been completely removed may live for months, carry on their vital functions of nutrition, respiration, circulation, even mating and production of young, but they show little or no initiative and almost no control of emotion. If the tail of a decerebrate cat is pinched or the fur rubbed the wrong way it flies into a rage and squalls, scratches, and fights.

One of the important functions of the cerebrum is to act as a brake on such basal emotions, to initiate, inhibit, and regulate behavior, and thus to bring about a balance between emotion and reason. The conflicts between reason and emotion are largely the result of a lack of proper balance between the two. All life is a balance between contrasting forces or principles, whether it be the life of plants, animals, or men. All living consists in preserving balance between the organism and the milieu, between heredity and environment, anabolism and catabolism, structure and function. Human life at its best is a proper balance between body and mind, emotion and reason, the material and the spiritual. The destructive conflicts between reason and emotion are caused by a lack of balance between the two, and not between reason and emotion as such, but rather between false reasoning on the one side and purely animal and unethical emotions on the other. There is no irrepressible conflict between the true and the good, the intellectual and the spiritual, the real and the ideal. On the contrary, they can be brought into harmonious balance and cooperation, as has been demonstrated in many well-balanced persons and social groups. The chief function of science is to

cultivate reason and to know the truth, that of religion is to cultivate the emotions and ideals and to promote harmony.

> Let knowledge grow from more to more,
> But more of reverence in us dwell;
> That mind and soul, according well,
> May make one music as before.

(1) *The Various Satisfactions of Life.* All animals seek the biological satisfaction of hunger, thirst, sex, and physical comfort. These are universal among animals and men. In social animals there are the additional needs and satisfactions of association and mutual protection, that is, "the herd instinct." All of these man shares with his humbler fellow creatures, and in addition he has the desire of social approval and the fear of disapproval, ambitions for power or wealth or superiority, and multitudes of other social desires that are chiefly the results of education and social environment.

In addition to these biological and social satisfactions, man experiences unique satisfactions of an aesthetic and ethical character. Types of aesthetic and ethical satisfactions depend in large part on social environment and education, as is shown by the great variety and even contradictory character of these. What is considered beautiful and desirable in one age and place is often deemed ugly and undesirable in another. Some persons derive pleasure from harmony in music, others from disharmony. Forms of art and literature that are prized by some are disliked by others. In similar manner, what is regarded as ethical under certain conditions is wholly unethical under others. In times of war, all peace-time codes of ethics are modified or abolished, and aggression, destruction, slaughter are sources of intense satisfaction. This shows that ethical satisfactions or dissatisfactions are dependent in large part upon social conditions and individual habits acquired largely by training.

Such diversity in forms of aesthetic and ethical satisfactions and dissatisfactions does not prove that there are no standards of values, nor that either west or "east of Suez the best is like the worst," but it does show that, in human estimation and practice, values are relative and not absolute. In this respect, science occupies no position of superiority; its findings are never to be regarded as absolutely true or false, but rather as approximations to truth. Absolute truth, beauty, goodness are ideals which have never yet been reached by man, but toward which mankind is advancing through innumerable trials and errors.

(2) *Science and Values: Science and Ethics.* It is often said that science has nothing to do with values; one might as well say that intelligence and reason have no relation to values. What are values but means and measures of satisfaction? It is impossible for a scientist, or any one accustomed to deal with evidence or to face reality, to appreciate the statement that science has nothing to do with values. It has certainly created innumerable conveniences and comforts, it has controlled diseases and pestilences, relieved suffering, and prolonged life. It has destroyed horrible superstitions such as witchcraft and demoniacal possession. It has enormously enlarged the experiences and the thoughts of men, and has made possible wider associations and closer cooperations among nations than were ever possible before. The fact that these possibilities have not yet been fully realized or have been abused is no denial of their value.

Values are means and measures of satisfaction, and they are compared by reason and judged by experience, which alone is able to judge the value of values. Intelligence and reason distinguish between physical, mental, and social satisfactions, between those of a purely temporary kind and the enduring satisfactions of life, between the selfish satis-

factions of the person and the ethical satisfactions that come from the welfare of others. Experience and reason are the only means by which we are able to evaluate the various kinds of satisfactions, that is, the value of values.

The ethics of science regards the search for truth as one of the highest duties of man; it regards noble human character as the finest product of evolution; it considers the service of all mankind as the universal good; it teaches that human nature and humane nurture may be improved, that reason may replace unreason, cooperation supplement competition and the progress of the human race through future ages be promoted by intelligence and good will.[1]

In all these respects the ethics of science does not differ from the ethics of Christianity. The fact that neither of these has yet revolutionized human behavior is no fault of the system of ethics proposed, but is due to the slow progress of human nature. The advancement of scientific knowledge has had a profound influence on the advancement of ethics, and will probably have a still greater influence in the centuries to come.

4. WAYS OF ESCAPE FROM HARD REALITY

Science seeks to distinguish truth from fiction, reality from unreality. But truth does not always bring satisfaction; often it is just the reverse. While knowledge brings power, it does not necessarily bring happiness. The writer of Ecclesiastes said, "He who increaseth knowledge increaseth sorrow." It may destroy our fondest hopes and most cherished beliefs, and consequently we often cling to our beliefs when evidence and reason show that they are false. We try to delude ourselves by saying that reason is fallible, and emotion and intuition are better guides. We

[1] E. G. Conklin, "Science and Ethics," *Science*, Vol. 86, No. 2244, Dec. 31, 1937.

shrink from the hard reality of truth and seek satisfaction in the soft comfort of fancy. Mankind in general is engaged in substituting fiction for fact, idealities for realities; it "prefers to believe," its thinking is wishful thinking. The more desperate the reality, the greater is the desire to escape from it.

(1) *Dream Life Versus Real Life.* One hundred years ago Bulwer-Lytton wrote a story *(Pilgrims of the Rhine)* of a poor, forlorn, and wretched man who had found surcease of sorrow in his dreams, and whose dream-life gradually replaced his waking life to his great satisfaction. Each night he took up his dream of wealth, position, friends, loved ones; each day he awoke to misery and longed to return to his pleasant dreams, until finally his real life came to an end in death.

This story is a sort of parable of all human life, much of which is sordid, sad, terrible. Men seek relief in dreams, waking or sleeping, often by means of narcotics, alcohol, opiates. The hard facts of life are covered over with pleasant fancies, the grim realities dissolve into charming idealities. But the dream does not last, and the real life is often made more hard and miserable than ever.

Pleasant fancies and fairy stories do no harm when they are recognized for what they are, or when they do not replace reality. Santa Claus as a symbol of the Christmas spirit is a popular saint, and we can applaud the editor who wrote to the little girl, "Yes, Virginia, there is a Santa Claus," for we know the fable is only half believed and will soon be replaced in her mind by the reality which it symbolizes. As we grow older we abandon childish fancies, but accept others that are just as unreal. Folklore, superstitions, magic are invented in order to explain mysteries or to escape from reality. We cover up a world of bitter reality with an imaginary one of pious make-believe.

(2) *The Beneficence of Nature Versus Reality.* Among these pleasant fancies is the belief that the earth was made for man and stored with oil, coal, and metals for his use; that grass and grain and fruits were made to grow for him; that flocks and herds were scattered over a thousand hills for his benefit. We fancy that no weeds or brambles grew in the earthly paradise and that Adam had an easy time of it before he had to make his living by the sweat of his brow.

But all such fancies take no account of reality. The utter indifference of nature to man and his welfare, as shown in earthquakes, hurricanes, floods, droughts, deserts, jungles, eternal ice, famines, and pestilences, are overlooked in these pleasant reflections on the beneficence of nature. The cruelties, sufferings, and deaths that are inflicted on sensitive and harmless animals by ferocious beasts and birds of prey, are forgotten or sublimated into a poetic belief,

> That not a worm is cloven in vain,
> That nothing walks with aimless feet.

It takes more faith than a biologist can muster to believe that. At best a realist can say that these animal victims are generally spared the agony of anticipation.

Over against nature's marvellous mechanisms for preserving life and health stands the infernal ingenuity of parasites that destroy both; balanced against the health and happiness of youth are the sorrows and ills of age. Any idealist who talks of the "beneficence of nature" should consider the millions of human beings condemned through no conscious fault of their own to the horrible sufferings of cancer or the hopeless shadows of insanity. Those who consider such things as unreal and existing only in "mortal thought" are to be congratulated on their ability to escape from hideous reality.

Nature is no *alma mater,* no tender mother; she says to

every living thing, "Root hog, or die!" All must adjust to her rigors or overcome them as well as possible. In short, nature is neither good nor bad, but is full of possibilities for both. Man must cultivate his garden, or weeds and brambles will overrun it. He must remake the world to suit his convenience, bridge chasms and rivers, tunnel mountains, and cut canals through isthmuses which nature thoughtlessly left between oceans. He must learn to control floods, conquer diseases, prevent pestilences and famines. In short, he must work out his own salvation.

(3) *Philosophical and Theological Ways of Escape.* We have already considered those systems of philosophy, such as idealism and solipsism, monism and animism, which attempt to eliminate the antithesis between the subject and the object, the ego and the world, and thus to remove the conflict between the real and the ideal. There are likewise theological philosophies, such as transcendentalism, pantheism, divine immanence, which undertake to transcend, idealize, and spiritualize nature, and thus to escape from the apparent evils of reality.

There are in addition many theological creeds, doctrines, and practices designed and intended to give comfort and hope to sufferers from hard reality, and to inspire courage and strength to overcome evil with good. Among these are beliefs in heaven and hell in a future life. The joys of heaven compensate for the woes of earth,

> Earth has no sorrow that heaven cannot heal.

Even "that blessed belief in hell" and the eternal punishment of the wicked satisfies our demands for justice which are often denied us in this life.

The doctrines of foreordination, denial of free will, and even belief in fixed fate are often a blessed relief from an overwhelming sense of personal responsibility. Likewise the

ability to throw all responsibility in matters of faith and conscience upon a church or priesthood is a blessed comfort to many perplexed mortals. Such theological doctrines do not have nor claim to have their origin in objective science. They are articles of faith based on revelation and inspiration intended to provide ways of escape from some of the bitter hardships of objective reality.

In these days of national and racial hatred and of wholesale destruction and murder, there is more than the usual excuse for belief in the existence of an infinitely malevolent and almost omnipotent Devil. But science has robbed us of the comfort of throwing all the discord of this troubled world on his Satanic Majesty. Even in modern theology he seems to have fallen from his once high eminence when he seemed more potent in this evil world than God himself. Accordingly, the horrors of war are often regarded by orthodoxy as divine punishments for the sins of men, albeit the punishment falls upon millions of innocent victims. Some church hymnals still echo this belief in a grand poem set to the music of the Imperial Russian Anthem:

> God, the All-Terrible! thou who ordainest
> Thunder thy clarion, and lightning thy sword;
> Show forth thy pity on high where thou reignest;
> Give to us peace in our time, O Lord.

The doctrine of original sin, which threw upon Adam the responsibility for the sins of the whole human race, was a comfortable way of escape from the reality of our own personal responsibility, but it is no longer very popular. It seems more true to fact to realize that "man's inhumanity to man" is more frequently the result of bad environment and bad education than of bad heredity.

(4) *Ways of Escape from the Reality of Death.* Perhaps no other flight from reality has ever been so agonizing and

so universal as the attempted escape from the actuality of death. In every age and land, men have tried every possible device to deny its reality or to hide its horrors. The dead body has been preserved by all possible means and has been laid away with its accustomed weapons, utensils, food, against the day of resurrection, when the spirit and life would return. For thousands of years the mummies of Egypt have awaited that resurrection, only now to be exposed in museums or to be ground up for fertilizer or made into paint and varnish.

We say with St. Paul, "By sin came death," forgetting that physical death came ages and ages before man appeared. Trilobites and ammonites, dinosaurs and titanotheres lived and died and became utterly extinct many thousands or millions of years before man appeared on earth. Unknown generations of proto-human beings lived and died and left their remains in the gravels of Trinil or the cave at Chou-kou-tien; countless generations of men of the old stone age lived and died and left only their bones and implements before the advent of *Homo sapiens*. Evidently it cannot have been the sins of modern man that first "brought death into the world and all our woe."

Saints, prophets, philosophers, and poets have found a way of escape from the reality of death through faith in the immortality of the soul. In this faith St. Paul cried,

> O death, where is thy sting?
> O grave, where is thy victory?

In this faith Longfellow wrote,

> There is no death! What seems so is transition;
> This life of mortal breath
> Is but a suburb of the life elysian,
> Whose portal we call Death.

This is a glorious faith, a conquering hope, which I would gladly share, but I am not aware of any sound scientific

evidence in favor of this belief. The seances of the spiritists in their darkened rooms and mysterious cabinets, and the anecdotal evidence of psychical research, leave most scientists cold and unconvinced. Belief in the immortality of the soul is based upon faith, and not upon scientific evidence. Indeed, such factual evidence as exists is negative and we may well cry,

> O star-eyed Science! hast thou wandered there,
> To waft us home the message of despair?

But there are other forms of immortality for which there is strictly scientific evidence, and although these do not satisfy our personal longings for persistence of consciousness, they seem to me to be finer and more ethical than the concept of a personal and sensuous immortality. One of these is *biological immortality* through our children and our children's children. This is a form of immortality that is highly regarded in the East but has been too much neglected in the West. We know that the stream of life in which we are eddies, has flowed out of the distant past, and without a break will go on through us to our latest descendants. In us our fathers and mothers and most distant ancestors live today, and in our children we will continue to live to their last generation. This is no theory, but absolute fact, for while the stream of consciousness is broken between generations, the stream of life is not.

Another form of persistence for which there is convincing evidence is *social immortality*. Men do not die and leave only their bones and implements, but "they rest from their labors and their *works* do follow them." Civilization is the product of the labor and influence of millions of persons, most of whom are wholly unknown to us. Only a few have achieved immortal fame, but many have left their immortal influence. Our lives have been shaped and moulded

not only by heredity, but also by environment, not only by the germinal elements of personality which we inherited from our parents, but also by the actual personalities that surround us. Every person radiates influences to every other one with whom he comes in contact, either directly or indirectly, and our characters are, to a considerable extent, the product of such influences. Heaviside, the English physicist, said on this theme:

> A part of us lives after death diffused through all humanity. The souls of a Shakespeare or Newton are stupendously large. Such men live the best part of their lives after they are dead. Maxwell is one of these men. His soul will live and grow for a long time to come and hundreds of years hence will shine as one of the bright stars of the past, whose light takes ages to reach us.

Many of the greatest men and women of the past left no children of their bodies, but the world is filled with the children of their minds and souls. We are the intellectual and spiritual children of philosophers and poets and scientists of former ages, of Socrates and Plato and Aristotle, of the prophets, apostles, and martyrs, and especially of that most influential character in all history, Jesus Christ. In us these great spirits live again, and in future generations may we also live again in our spiritual children! This social immortality of thought and deed has been nobly expressed in that well-known poem by George Eliot:

> O may I join the choir invisible
> Of those immortal dead who live again
> In minds made better by their presence: live
> In pulses stirred to generosity,
> In deeds of daring rectitude, in scorn
> For miserable aims that end with self,
> In thoughts sublime that pierce the night like stars,
> And with their mild persistence urge man's search
> To vaster issues. . . .
> This is life to come,
> Which martyred men have made more glorious
> For us to strive to follow. May I reach

That purest heaven, be to other souls
The cup of strength in some great agony,
Enkindle generous ardour, feed pure love,
Beget the smiles that have no cruelty—
Be the sweet presence of a good diffused,
And in diffusion ever more intense.
So shall I join the choir invisible
Whose music is the gladness of the world.

These forms of immortality may be small comfort for egoists who look forward to an endless life of conscious pleasure, but they should give us a greater interest in the future of mankind and increased desire to be found worthy to share in that future.

5. REALISM WITHOUT IDEALISM LEADS TO PESSIMISM

And here we return to the antithesis between science and faith, knowledge and desire, the real and the ideal. Science seeks to know the truth, even though it may be unwelcome. "Truth is truth, even though it sears our eyeballs" and destroys our hopes. It was this conflict between the real and the ideal, between emotionless science and pleasant tradition that led Wordsworth to write,

Great God! I'd rather be
A Pagan suckled in a creed outworn,
So might I, standing on this pleasant lea,
Have glimpses that would make me less forlorn;
Have sight of Proteus rising from the sea,
Or hear old Triton blow his wreathed horn.

The fact that nature is indifferent to our weal or woe, that disease, suffering, and death are the portion of all, that man's inhumanity to man frequently makes a hell of earth—these facts, if there were no escape, would necessarily lead to pessimism and despair. Such a philosophy of despair is not confined to scientists, but is found among all those who see in human life only aimless suffering and

evil with no faith in progress and no hope for the future. It led Mark Twain, near the end of his life, to write:

> A myriad of men are born; they labor and sweat and struggle for bread; they squabble and scold and fight; they scramble for little mean advantages over each other. Age creeps upon them; infirmities follow; shames and humiliations bring down their prides and their vanities. Those they love are taken from them, and the joy of life is turned to aching grief. The burden of pain, care, misery grows heavier year by year. At length ambition is dead; pride is dead; vanity is dead; longing for release is in their place. It comes at last—the only unpoisoned gift earth ever had for them—and they vanish from a world where they were of no consequence; where they achieved nothing; where they were a mistake and a failure and a foolishness; where they have left no sign that they have existed—a world which will lament them for a day and forget them forever. Then another myriad takes their place, and copies all they did, and goes along the same profitless road, and vanishes as they vanished—to make room for another and another and a million more myriads to follow the same arid path through the same desert, and accomplish what the first myriad, and all the myriads that came after it, accomplished—Nothing!

If it be true that "he that increaseth knowledge increaseth sorrow," and that the only way to be happy is to forget, or to shut one's mind to reality, then Jacques Loeb was right when he once said bitterly to me, "The evolution of consciousness was the greatest blunder in the universe"—meaning that if only we had remained unconscious it would not have mattered that there is no plan or purpose in nature or in human life and that death ends all for the individual and the race.

But such pessimistic views of man and of human prospects are not justified in reality. They represent a partial and defeatist view of "the human situation." Neither Mark Twain nor any other philosopher of despair could avoid the urge to work for human betterment. The deeper currents of their lives run counter to these eddies on the surface. Laborious days and thoughtful nights reveal their faith in human worth and progress, and their despair indicates chiefly their discontent that progress is so slow.

It is impossible to live such a philosophy of negation, a philosophy of despair and suicide, rather than of hope and life. Surely there must be something wrong with any philosophy that cannot be lived. In science, the test of reality is not logic or philosophy, but the appeal to fact, and the practical test of any system of philosophy should be its livability.

(1) *Reason not at Fault.* Let us go back and see where we took the trail that led to this slough of despond. Certainly it was not in following the light of reason in dealing with these great problems, for although we may with Darwin doubt whether the mind of man can be trusted when it draws such grand conclusions, it is not reasoning itself that is at fault, but imperfect reasoning. Reason may be "but a feeble flame by stumblers carried in a starless night, and yet it is our only light." Even revelation must be interpreted by reason, and those who advise us in the interest of preserving our childhood's beliefs to "take our reason captive" are counselling what is not only impossible but also positively irreligious, for we are commanded to worship the God of truth with all our mind, as well as with all our heart. Will any fundamentalist maintain that we alone of all living creatures were given reason to deceive us and to lure us to destruction? The old war cry against rationalism will no longer avail; we will not be frightened by names. No, we have not strayed from the highway of truth into this morass by following sound reasoning, but rather by following faulty mental processes that will not bear the test of actual experience. The only remedy and substitute for poor reasoning is better reasoning, and not its total elimination.

(2) *Science not Responsible.* We have not departed from the highway of truth by accepting the findings of science regarding the immensity of nature and the smallness of man.

The sciences of astronomy, geology, and biology have so enormously enlarged our views of the universe that space and time have become practically infinite and the days of creation have become billions of years. This enlargement of nature has led to a corresponding shrinkage of man when measured by standards of space and time; but when measured by reason, conscience, aspiration, it is a different story. For the first time in the long history of life on this planet there has appeared in man a creature capable, to a certain extent, of understanding and measuring this wonderful universe and of controlling some of its processes. By this measure, man is not an insignificant creature; the magnitude of the universe has not dwarfed the mind and soul of man.

The teachings of biology as to the animal ancestry of man, or as to his development from germ cells, have not degraded man and produced this utter pessimism. All the greatest leaders of mankind were once babies, and before that germ cells, and often they have had neither distinguished parents nor notable offspring. Lowly origin is not incompatible with ultimate greatness, as none know better than the countrymen of Franklin and Lincoln. Nature and human history proclaim the fact that superlative greatness may have very humble origins. The worth and dignity of man consist in what he is and in what he may become.

Evolution deals only with mechanisms and processes, and does not touch the question of ultimate causation. The greatest problem here is not the mechanism of evolution, but the evolution of this mechanism. In all human experience, mechanisms and machines do not create themselves. What lies back of these mechanisms of evolution, and indeed of all nature, no one knows. The atheist sees only chance and accident. The theist sees back of all mecha-

nisms and laws, divine power and plan. The Christian sees a Heavenly Father. Science cannot deal with this mystery; it is a matter of faith and ideals.

It was objected to Newton's law of gravity that it drove God out of his universe and put a law in his place. The same objection has been made by many opponents of evolution; and yet a natural law is only a "stated, fixed, settled"[1] method or process, and surely there is no more evidence of divine power in a chaotic and capricious universe than in an orderly and lawful one. On the other hand, if the universe were a chaos instead of a cosmos, it might be taken to mean that everything is the result of chance. The very existence of order in nature seems to imply some other governance than chance. But while nature is "stated, fixed, settled," its determinism is not predeterminism. Determinism means that every event is the result of a chain, or rather a network, of preceding causes; predeterminism attributes every event to a single original cause; the one is scientific determinism, the other fatalism. From every source, evidence is accumulating to show that natural events are not rigidly fixed and predetermined. Even in the more exact sciences of physics and chemistry there is, as Charles Galton Darwin has recently said, a certain "fuzziness" or variability in all phenomena. This is much more apparent in living things where the network of cause and effect is very complicated, and events correspondingly much more variable.

These same considerations apply to human life and activity as well as to the outside world. There is no sufficient evidence that the body, mind, or morals of man are wholly the results of caprice or chance, nor, on the other hand, that

[1]Bishop Joseph Butler's definition of Nature in his *Analogy of Natural and Revealed Religion.*

they are absolutely predetermined. The determinism of heredity and environment is not predeterminism, and in the case of man it is certain that it does not destroy all freedom and responsibility. As a matter of fact, we know that our wills are not perfectly free. Heredity and early environment have set bounds about us that we cannot pass, but within those bounds we have a certain amount of freedom and responsibility. We are partly bound and partly free. Within certain limits we may be held responsible for making right choices between alternatives that are offered, but we cannot directly make the alternatives nor always choose between them. In short, human freedom and responsibility are relative and not absolute, and the truth of this is recognized in the laws and customs of all civilized countries. The concept of universal law when applied to the individual or to society does not, when properly understood, destroy human freedom and responsibility, and to this extent man is a "free moral agent."

(3) *Is There Plan and Purpose in the Universe?* Perhaps more than anything else pessimism and despair are caused by the thought that there is no plan or purpose in the universe or in human life, and that everything is the result of chance and accident. Undoubtedly chance, in the sense of numerous causes that cannot be recognized and formulated, has played a large part in the evolution of worlds and of organisms, but there is no scientific evidence that it has played the only or the leading part. Chance has determined many things in our lives, but there is no compelling evidence that our evolution and development have been purposeless. We know as well as we know anything that we have aims and purposes. Where did they come from? How did they develop in a purposeless universe? I cannot understand how anyone can take the long view of

nature that science reveals, can follow the course of evolution from the formation of atoms to the appearance of man with his intellect, consciousness, and aspirations, and still believe that it is all without plan or purpose.

But it is not possible to *prove* that the constitution of the universe and the whole course of inorganic and organic evolution embody an original plan or purpose, nor, on the other hand, can it be proved that they are all the results of chance. We have previously seen certain evidences that life processes are essentially teleological; furthermore, the fact that higher animals, such as birds and mammals, seek satisfactions and avoid dissatisfactions shows that there is something more than mere chance involved in their behavior. We do not know how far down in the animal scale there is conscious purpose, but in man, at least, nothing is more certain than the conscious seeking of satisfaction and purposive efforts to reach certain desired ends. If there never before was any such thing as purpose in the whole universe, there is purpose now in the life and activity of at least one species, *Homo sapiens*.

Pessimists who hold that there is no plan or purpose in human life and that extinction is the goal toward which we as individuals and a race are inevitably driven, may well ask what's the use of efforts for improvement of the individual or the race? What's the use of education, eugenics, ethics, religion? What's the use of science, discovery, or invention? What's the use of ideals or goals or ends? What's the use of anything? Nothing! Utter pessimism is the outcome of such a philosophy, and death the only boon.

Here is, after all, the point from which one takes the path that leads to hope or to despair. If there is no purpose in the universe or in man, then indeed there is no God and no good. But if there is purpose in nature and in human life,

if there are ideals of truth, beauty, love, and peace to be worked for and attained, then we may conclude that it is only the imperfection of our mental vision that leads us sometimes to cry with the author of Ecclesiastes and other pessimists, "Vanity of vanities, all is vanity."

6. IDEALS AS GOALS

Ideals are not merely ways of escape from hard realities; what is much more important is they are stimuli to goals that have not yet been reached. For the first time in the long history of life on earth, there has appeared in man a creature capable of taking a conscious part in his own development and evolution. He may not be literally "Master of Destiny," but he can at least plan and work to make his ideals become realities.

All that man now has of value beyond what is found in wild nature has been gained by human effort. The whole progress of mankind from savagery to civilization has been won by the struggle to make ideals become real. The ideals that have been most potent in human progress have been those which aimed at (1) physical comfort and well being, (2) social security, order, dominance, and power, (3) individual and social freedom, (4) improvement of the individual and the race in body, mind, and morals. Science has contributed enormously to the realization of many of these aims, but it furnishes only means of progress and can influence only indirectly aims and ideals.

(1) *Ethical Goals.* The social conflicts, revolutions, and wars of today are struggles to reach certain goals which are thought to be better than existing realities. Many of these ideals may seem to us foolish, wicked, and destructive of all progress in freedom, ethics, and human welfare, but to their proponents they seem to be desirable goals. But

in order to reach these goals, they destroy the freedom, welfare, and lives of the people of other nations and races; their ideals are too narrowly limited to their own people. The world is cursed with primitive tribal ideals of ethics, with "cheap, vernacular patriotisms," duties being limited to particular social classes, nations, or races. Nothing less wide than a system of planetary ethics will suffice in so small a world as this.

In the course of human history, ideals of ethics have undergone slow development both in substance and in breadth of application. The crude ethics of earlier times was again and again condemned by Jesus: "Ye have heard that it hath been said, Thou shalt love thy neighbor, and hate thine enemy. But I say unto you, love your enemies, bless them that curse you, do good to them that hate you, and pray for them which despitefully use you, and persecute you. . . . For if ye love them which love you, what reward have ye? Do not even the publicans the same?" "Whatsoever ye would that men should do to you, do ye even so to them." The extraordinary advance of Christian ethics over that of the Jews and all pagan systems was shown in the very fact that it taught an ideal of universal human brotherhood, "Where there is neither Greek nor Jew, Barbarian, Scythian, bond nor free." The world has a long way to go before it realizes these high ideals, but they shine as beacon lights in a dark and stormy night.

Recently a great outcry has been raised against science because it is said to teach no ideals of values and ethics. But if there is any place where truthfulness is more prized and conscious falsehood more fatal than in science, I have yet to hear of it. If there is any occupation in which freedom is more necessary than in science, where is it? The true scientist must be free to search and to proclaim,

without fear of prejudice or authority. If there is any subject which is more dependent upon honest and honorable cooperation than science, I should like to learn of it. Where else than in science will you find in our modern world a more perfect illustration of genuine internationalism than among scientists? As an illustration of scientific internationalism I call attention to an announcement from the British Association for the Advancement of Science, dated London, February 21, 1941, of its "decision to join with American scientists in preparing a Democratic Charter of Science to be observed by scientists throughout the world. The first principle to be laid down will be that the fellowship of the commonwealth of science has service to all mankind as its highest aim, and the whole world as its outlook. The Charter will not recognize any barriers of race, creed, or class." If truthfulness, freedom, honor, humanitarianism, internationalism, universal brotherhood are not ethical ideals, there may be some ground for claiming that the methods, results, and pursuits of science are unethical and are "destroying western culture."

Two days after the announcement by the British Association of the proposed "democratic charter of science" the news from Rome carried Mussolini's speech in which he called for "that cold, conscious, implacable hate, hate in every home, which is indispensable for victory." A few days later, *Popolo d'Italia,* Mussolini's newspaper, carried an editorial which closed with these violent words: "We must hate England as our Roman forefathers hated the Carthaginians and as our fathers hated the Austria of the Hapsburgs. Thus with hate in our hearts we will reach total victory. Therefore, hate the enemy and God curse England!"

Is the world suffering today from too much reason, too much calm science, or too much uncontrolled emotion? Our

greatest dangers, against which we most need national defense, are such wild emotions as these. Emotionalism, sensationalism, irrationalism are our chief dangers, and unless we learn to control these by reason they will destroy us.

(2) *The Need of Religion.* The real and the ideal are not necessarily in conflict; they are antithetical but not antagonistic. Here, as in the antithesis between reason and emotion, there may be cooperation instead of conflict. Again, the desirable condition is one of a proper balance between them. Long ago it was said, "Where there is no vision the people perish." "Man shall not live by bread alone, but by every word of God." Both reality and ideality are necessary for happy and useful living. We must build on the rock of fact, but up into the atmosphere of ideals. Realism without idealism ends in pessimism.

It is here in the realm of ideals and aspirations, as well as in rational processes, that man is most distinct from all other animals. And it is here that one recognizes most clearly what men have generally called divine influence. The real largely refers to what is past, the solid foundation of fact, the forces of nature that *drive* us on. The ideal looks more to the future, to the making real of what is at present only ideal; it is the force which *draws* us on to better things.

The supreme social service of religion is to breathe into the realism of science the spirit of lofty idealism; to cultivate among all classes, races, and nations of men, justice, peace, and mutual service. The needs for such religion are universal and eternal. It can never be replaced, for there are no substitutes that can take its place; neither science, art, nor forms of social organization, such as democracy, fascism, or communism, can be substituted for it. It can never be outgrown, for its need is omnipresent and ever

increasing. The greater the specializations of science become, the greater are the needs of such religious integration. The spirit of enlightened religion is that of faith, hope, and love; its aim is the cultivation of truth, beauty, morality; its great purpose is to promote the progress of mankind toward the ideals of the Kingdom of God on Earth. Too often, religious organizations have minimized these social and mundane functions by devoting their major efforts to the preparation of individuals for a future life of bliss in some other world than this, neglecting the leading petition in the Lord's Prayer, "Thy Kingdom come, Thy will be done on earth, as it is in heaven."

Of course, in a very important sense, religion is a personal matter. Edward Caird, the great Scottish theologian, once said, "A man's religion is the expression of his ultimate attitude to the universe." Indeed, every man has some form of religion, however irreligious it may seem to those whose attitude to the universe is different from his own. In this sense, religion includes a man's entire personality; his intellect, emotions, will; thoughts, aspirations, ethical principles. But a purely personal religion fails to accomplish much of a lasting nature for human society. Because of the greater power and permanency of society, all types of religion have established social organizations in which individuals are united by some integrating principle, such as common doctrines, dogmas, and creeds. Many of these ancient beliefs dealt with the nature of the world and man, and in this field they have frequently come into conflict with modern science.

To many persons, religious creeds and dogmas are peculiarly precious. In an age of scientific, social, and religious evolution they wish to preserve unchanged the faith of the fathers. This feeling is very human and understandable.

We all want sure foundations in material, intellectual, and social affairs. Earthquakes and social revolutions are uncomfortable, if not terrifying, and yet new knowledge is continually shaking old systems of science, philosophy, and religion.

The antagonism of many scientists to religion is largely antagonism to ancient creeds. They sometimes identify religion with every absurdity or religious belief of primitive ages and stages of culture. There are also many currently accepted religious dogmas that scientists find it difficult, if not impossible, to accept. This is not so much a revolt against religion as one against the clothes in which religion has been dressed—a revolt against outworn creeds and dogmas in which men long ago clothed their religion. But, in spite of all such criticisms, the needs of a genuine spirit of religion were never more evident. The first question and answer in the old catechism is, "What is the chief end of man? To glorify God and enjoy Him forever," which in the language of science may be interpreted, the chief end of man is to make the highest ideals become real, and thus to bless future generations.

No one can furnish scientific proof of the existence or nature of God, nor of a divine plan in the fulfillment of which men may cooperate, but it is evident that such ideals lend strength and courage to mortal men. Religious faith and ideals give the largest value to human life and the greatest stimulus to efforts for improvement. "By their fruits ye shall know them."

7. CONCLUSION

"What is man?" Realists reply, "What is he not?" Saint, sinner; despot, slave; tyrant, victim; brute, angel; wise, foolish; sane, insane; and so on to the end of all possible

contraries. Alongside of generosity we find meanness; of sympathy, cruelty; of purity, filth; alongside of humanitarianism is "man's inhumanity to man"; in contrast to medicine, sanitation, and the saving of life are the most fiendish massacres and atrocities; the most hopeful plans for peace are met by the most destructive preparations for war.

Idealists forget realities when they picture the dignity and value of every human being. There is much unreal talk about the infinite worth of every soul. Whose soul? That of murderers, kidnappers, fiends, and devils? Unless they can be reformed and regenerated their value is negative. In similar vein there is just now much democratic fustian about the rights of every individual to perfect freedom. Whose freedom? That of robbers, gangsters, rapists? There can be no absolute freedom in any society, and for criminals it must be relatively much less than for law-abiding citizens. Idealists are right in affirming the *potential* worth and dignity of every person who can by any possible means become valuable and dignified, but they do not consult reality when proclaiming the *actual* value of every living soul.

"What is man?" The answer of the natural sciences has been presented in these lectures, and may be summarized briefly. There can be no reasonable doubt that man is a part of nature, that he has descended from earlier animals less highly developed in psychical and social qualities, and that he still bears in his entire nature the marks of his lowly origin. It is certain that in each generation he develops from germ cells, and that in body, mind, and morals he is the product of heredity and environment.

But, making all allowances for this humble origin, it is still true that man is a unique living being. He alone uses articulate speech to express ideas; he alone has the power of generalization and abstract thought, as contrasted with

knowledge of specific things which higher animals have. He alone has a keen sense of right and wrong, of justice, responsibility, and ethics. He alone has intellectual and spiritual ideals that urge him on to vaster issues. Who more than the scientific realist can appreciate the words of Shakespeare: "What a piece of work is a man! how noble in reason! how infinite in faculty! in form and moving how express and admirable! in action how like an angel! in apprehension how like a god!"

But the realist sees also the other side of this picture. No other living species has so many congenital defects as man; no other so many botched, bungled, helpless specimens. In body, mind, and morals the highest and lowest types of men are worlds apart. Contrast the achievements of minds that have explored the depths of the universe, the constitution of atoms, the mysteries of life and mind, with the inanities and insanities of the human herd; the heroic souls that have dared great adventures, with the slaves who are but "dumb driven cattle"; the composers and creators of great music, literature, and art, with the multitude whose highest thoughts are of animal comforts; the monsters of hate and depravity, with "the Lord Christ's heart and Shakespeare's brain."

Here we have, in sharp contrast, extremes of the real and the ideal in man. But the fact that ideals have been made real in some men lends hope and inspiration to efforts for human betterment. With this sad contrast between the real and the ideal in mind, Omar Khayyam wrote:

> Ah Love! could thou and I with Fate conspire
> To grasp this sorry Scheme of Things entire,
> Would not we shatter it to bits—and then
> Re-mould it nearer to the Heart's Desire!

We cannot grasp this sorry scheme of things entire, nor shatter it to bits, but fortunately we can in many ways re-

mould it nearer to the heart's desire. That is what man has been doing ever since he brought intelligent purpose to bear upon his problems. Ever since he first made weapons and tools and used fire and clothing, he has been moulding things nearer to his heart's desire, and who can fix any limit upon this process? Certainly an age in which our control over environment is going forward at terrific speed is no time to despair of further progress. Even the remoulding of human character for good can be and must be achieved.

Society is in the throes of revolutionary changes which are inspired by the desire to shatter things to bits and then remould them nearer to the heart's desire. But if such desires are not wise and just they produce ruin rather than progress. This shattering of things to bits in order to remould them nearer to the heart's desire is the nihilist, anarchist, bolshevist, fascist, national-socialist method—the method of revolution rather than that of evolution, of tyranny and compulsion rather than of freedom and education, of autocracy rather than of democracy. All development builds on what has gone before, and not merely on its ruins. All biological, intellectual, social advance has been made in this way. Utter ruin ends in extinction, and not progress. The very fact that man can modify and shape his environment and to a more limited extent his own reaction patterns, behavior, and character, points out the possibility of moulding things nearer to the heart's desire.

But, to be of any real effect, ideals must lead to action. Mere visions, dreams, wishful thinking accomplish nothing. Faith that will remove mountains must be put to work with steam shovels. Many persons regard faith as all-sufficient in itself, but such faith is as vain as the schoolboy's definition, "Faith is that quality that enables us to

believe what we know to be untrue." On the other hand, to the Apostles, "Faith is the *substance* of things hoped for," and "Faith without *works* is dead." We are commanded to "work out our own salvation," and we may be sure that, unless we put our ideals to work, they will never bring improvement or salvation.

Man cannot live and prosper without ideals, and society disintegrates without social morale. Professor William McDougall found in Borneo that "social integration was proportional to warlike habits." When dangers of foes relax, social integration decreases, and the larger society breaks up into classes, parties, labor unions, etc. Is it possible to maintain social unity and moral fiber in the absence of fear? The dictators say, No! and they obtain a kind of unity by means of force, concentration camps, and bloody purges, which destroy all real freedom. Even in our democratic society we often appeal to fear or force to bring about social unity, and of course in war individual freedom must be suspended for the time being. Indeed, real democracy works well only in times of peace.

But in times of peace and prosperity social unity is endangered by the clashing interests of different classes; strikes and sabotages multiply, party rancor increases, and cooperation by peaceful and rational persuasion sinks to a dangerous level. It seems that a certain amount of fear and hardship is necessary to bring about general social unity.

But even worse than this loss of cooperation in times of prosperity is the loss of ethical ideals and the rot of moral fiber. Decay of ideals of honesty, temperance, industry, and fidelity in all relations flourishes in those very circles that are most prosperous and have least to fear. Indeed, without deep-seated and compelling ideals of personal honor and responsibility, men revert to the animal condition, where

the higher forms of ethics decay. It seems that man cannot endure too much ease and prosperity without degeneration. Here, as in the field of physical well-being, struggle is necessary for progress. "Man is always at his best when rowing against the stream," and it seems to be true that "mankind is educible only when miserable." "Sweet are the uses of adversity." Therefore, the ideal condition is not "peace, perfect peace," but rather struggle to maintain high ideals.

Human progress must take other directions than the pursuit of wealth, comfort, luxury, even individual freedom. Our society is too much concerned with maintenance of individual rights. The American Revolution was a struggle for the rights of man—the inalienable rights of life, liberty, and happiness. We need and perhaps are now having a new Revolution to emphasize the duties of man. The ideal state of Plato was one in which each should do his duty and contribute to the welfare of others, but he would be a one-eyed philosopher who emphasized only duties, and wholly neglected rights. The growing dependence of individuals upon the state is a long step in the direction of a totalitarian society in which the individual loses his rights and freedom and becomes a pawn in a game played by dictators. The fundamental difference between autocracy and democracy is that, in the former, "the state" is one or a few individuals without responsibility to the populace; in the latter, the leaders are the free choice of the people and are responsible to them. Leaders are necessary in all forms of society, but there is a world-wide difference in the manner of their becoming leaders.

Practically all the disorders of society are man-made and can be man-cured. Aggression, tyranny, hate, war are not forced upon mankind by a cruel nature; they are purely hu-

man in origin, and it is in the power of man to control or abolish them. No doubt this will be a long and hard task, but time is long, man can learn by experience, and some men at least are brave and welcome adventure.

The long course of organic evolution justifies faith in further progress. The evolutionist knows that the great stream of life has meandered in many directions and that there have been many eddies and back currents, but he knows that on the whole there has been no permanent retreat in the evolution of intellect, reason, and ethics. There is some perfecting principle in all life and evolution, and in the case of man "some power not ourselves that makes for righteousness" (rightness). Through all the ages of man's past history, and in spite of many mistakes and failures, the current of his development has been leading to wider intellectual horizons, to broader social outlooks, and to more generous forms of ethics. In spite of wars that "threaten civilization," there is no sufficient reason to believe that this great current will cease to flow today or tomorrow. In the course of ages man will learn, by trial and error if not by intelligence and reason. We are today only children in the morning of time, and before us lie the countless centuries and millennia of man's vast future.

Edwin Grant Conklin.

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